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NAVAL SUPPLY SYSTEMS COMMAND: DATA ADMINISTRATION PLANNING AND IMPLEMENTATION

by

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Paul R. Richey

March 1989

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The Paperwork Reduction Act of 1980 mandated that federal government activities establish and enforce Information Resource Management policies. It also recommended the establishment of a Data Administration Branch within federal activities to provide an organizational entity devoted to effective information management. This study presents guidelines for the successful implementation of Data Administration, describes a standard for an Information Resources Dictionary System (the Data Administrator's primary tool), and makes recommendations for planning an Information Resources Dictionary System implementation.

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The Paperwork Reduction Act of 1980 mandated that federal government activities establish and enforce Information Resource Management policies. It also recommended the establishment of a Data Administration Branch within federal activities to provide an organizational entity devoted to effective information management. This study presents guidelines for the successful implementation of Data Administration, describes a standard for an Information Resources Dictionary System (the Data Administrator's primary tool), and makes recommendations for planning an Information Resources Dictionary System implementation.

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I. INTRODUCTION

A. BACKGROUND

The Naval Supply Systems Command's (NAVSUP) mission is to develop, manage, and operate the Navy Supply System. This system exists to provide supplies and services to satisfy the mission requirements of the fleet and shore commands during peacetime and wartime. [Ref. 1:p. 6-1]

Supply is a pervasive function that affects every activity within the Navy and many commercial contractors as well. This global scope presents NAVSUP with the difficult challenge of controlling, coordinating and exploiting a complex information resource environment.

Difficulties arise because, until recently, NAVSUP created separate information systems and applications to meet specific needs. This approach resulted in an amalgam of stand-alone systems. Today these aging systems exhibit many of the classic problems which provide the impetus for the contemporary Information Resource Management (IRM) movement: data redundancy, data inconsistency, uncertainty about data validity, undisciplined data exchanges, uncontrolled data creation, unmanaged system growth, and increasing program maintenance costs.

Although these problems still exist, NAVSUP is now using IRM techniques to modernize its information systems. For

example, NAVSUP has adopted an information engineering approach for all new systems development.[1] In addition, a Data Administration (DA) organization presently exists which is in the process of developing a Corporate Data Dictionary. A Corporate Data Dictionary contains information about "basically any information entity--a program, user, hardware, or decision model" [Ref. 2:p. 48] that is shared in an organization. The Corporate Data Dictionary is also referred to as an Information Resource Dictionary System (IRDS).

Successful IRM implementation will provide the means to control, coordinate, and exploit NAVSUP's information resource. With Department of Defense (DOD) budget cuts imminent, effective and efficient IRM is crucial to NAVSUP's ability to provide uninterrupted service to afloat and ashore customers in the 1990's and beyond.

B. STUDY OBJECTIVES AND SCOPE

This study examines a piece of the IRM infrastructure at NAVSUP and its subordinate commands, specifically, Data Administration and the use of Information Resource Dictionary Systems. The objectives are to identify problems and issues

[1]Information engineering is a structured methodology for systems design and analysis. For a review of information engineering methodology and NAVSUP's information engineering approach, see Sharon A. Stanley's Master's Thesis, Naval Postgraduate School, Monterey, California, Information Engineering in the Department of Defense: Two Case Studies, September 1988.

hindering the successful implementation of this IRM subset and to provide solutions and guidelines for their resolution.

The study encompassed NAVSUP Headquarters, two Inventory Control Points (ICP), six Naval Supply Centers (NSC), and five system support offices responsible for functional area support, e.g., Navy Food Service Systems Office (NAVFSSO).

We chose these activities for three reasons. First, each one employs automated information systems to perform supply functions. Second, each of these activities must follow supply related IRM policies established by NAVSUP. Lastly, together they constitute a sample size large enough to gauge accurately the extent and depth of DA and IRDS implementation at NAVSUP and its subordinate commands.

C. RESEARCH METHODOLOGY

The research methodologies used for collecting data included a thorough review of pertinent literature to ascertain the current practice of Data Administration and Information Resource Dictionary System implementation. Subsequently, interview and survey techniques provided data on NAVSUP's progress and problems in these areas.

Interviews included in-person and telephone discussions with NAVSUP's Data Administrator, Fleet Material Support Office (FMSO) Data Administration personnel, and Information Engineering Systems Corporation (IESC) employees. IESC is a commercial vendor contracted to create a Corporate Data Model

and a Corporate Data Dictionary for NAVSUP. Additionally, we designed a survey to capture Data Administration and Information Resource Dictionary System implementation status at NAVSUP activities. The survey was sent to the Data Administrators of the commands listed in the Study Objectives and Scope section above.

Lastly, a comparison between accepted DA and IRDS standards and NAVSUP's implementation status resulted in proposed solutions and guidelines for handling unresolved implementation issues.

D. STRUCTURE/PREVIEW OF THE THESIS

The remainder of the thesis structure is as follows:

- Chapter II presents the findings of the literature review, including the current standards of Data Administration and identification of critical factors for its successful implementation.
- Chapter III describes the new Federal Information Processing Standard (FIPS) for an IRDS, and identifies the planning steps that need to occur before implementing an IRDS.
- Chapter IV includes a brief description of NAVSUP's environment, an explanation of the methods used to collect data about NAVSUP's DA and IRDS implementation status, and a comparison of findings with the frameworks established in Chapters II and III.
- Chapter V presents a summary of findings, recommendations for a NAVSUP DA strategy, and areas for further research and study.
- Appendix A contains a list of abbreviations.
- Appendix B contains the NAVSUP Strategic Information System Architectures and Guidelines.
- Appendix C is a copy of the NAVSUP Data Administration Survey.

II. CRITICAL FACTORS FOR SUCCESSFUL DATA ADMINISTRATION

A. LITERATURE REVIEW

Our literature review yielded four major findings pertinent to this study:

- a current definition of Data Administration functions;
- identification of ten critical DA implementation success factors;
- a standard for Information Resource Dictionary Systems;
- a framework for IRDS implementation.

The literature review consisted of an on-line Dialog search[2] directed around the following keywords: "Information Resource Dictionary System," "Information Directory Dictionary System," " Data Dictionary," "Data Dictionary Implementation," "Data Element," "Data Element Dictionary," and "Directory System." This search produced a list of hundreds of articles which we subsequently narrowed to about twenty with direct applicability to our study.

The Knox Library at the Naval Postgraduate School provided the Dialog search and helped in obtaining articles from other libraries in California. In addition, we reviewed several theses at the Knox Library addressing Data Administration and Data Dictionaries.

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[2]Dialog is an information retrieval service. It indexes on-line over 300 databases.

Fewer than ten books on Data Administration and Data Dictionaries were identified by the search. The relative newness of DA as a discipline explains the scarcity of books. Three of the four main book references used in our study appeared within the last three years.

The reader should view the DA critical success factors and proposed strategy for IRDS implementation presented in this study as guidelines and not hard-and-fast rules. Except for the IRDS, standards do not exist for the other findings gleaned from the literature review process. It is important to remember that the definition of DA is still evolving. Strategies developed today for its successful implementation may not be appropriate for the future.

B. AN INFORMATION RESOURCE MANAGEMENT FRAMEWORK

IRM has evolved from the well-accepted notion of data as a primary resource in an enterprise. IRM refers to more than just controlling data, however. It includes not only all forms of corporate data such as voice data, image data, and text data [Ref. 2: p. 176], but also policies, programs, and manual records as well.

In the public sector, Congress provided an impetus to IRM by passing the Paperwork Reduction Act (PRA) of 1980 [Ref. 3:p. 6]. The PRA mandated that IRM policies be established and enforced across the federal government. The PRA stressed better management of information technologies such as

automated data processing and telecommunications systems. It specifically required the review of information management activities. The PRA also recommended the establishment of a Data Administration Branch as part of the Information Systems Management and ADP Security Division to provide an organizational entity devoted to effective information management.

The National Bureau of Standards (NBS), Special publication 500-512 defines IRM as "... a set of policies for the coordinated management of an enterprise's information resources for systems development, operation, and maintenance." These policies describe objectives and procedures to provide information availability, timeliness, accuracy, integrity, privacy, security, traceability, ownership, use, and cost-effectiveness. In addition, they provide the structure to coordinate information management, processing, communications, and conversion. [Ref. 4:p. 12]

IRM is a synchronized organization-wide policy for information control. This policy emphasizes meeting the myriad information requirements of diverse users. Data Administration is one vehicle that helps IRM fulfill these many user requirements.

C. THE PRACTICE OF DATA ADMINISTRATION

Data Administration is a corporate concern that recognizes data as a resource.

> DA is the establishment and enforcement of policies and procedures for managing the company's data as a corporate resource. It involves the collection, storage, and dissemination of data as a globally administered and standardized resource. [Ref. 5:p. 794]

The primary mission of DA is effective information management in accordance with overall IRM objectives [Ref. 4:p. 12]. The DA function encompasses all technical and management activities required for organizing, maintaining and directing a data environment as shown in Table 1.

Many of the DA goals interrelate in their support of IRM objectives, for example, developing data as a manageable, usable resource supports information availability. Without manageable data, IRM objectives can never materialize. Cataloging and inventorying the data resource supports security, ownership, and traceability objectives, and enhances data integrity. Timeliness is an IRM objective which also supports cost-effectiveness. Documenting use of the data resource aids in security and traceability, and helps ensure privacy. Eliminating unwanted repetition and improving maintenance of the data resource supports the accuracy, integrity, and cost-effectiveness objectives of IRM.

TABLE 1. DATA ADMINISTRATION GOALS, TOOLS, AND ACTIVITIES

DATA ADMINISTRATION GOALS:
-Develop data as a manageable, usable, resource
-Catalog and inventory the data resource
-Provide timely availability of data
-Document use of the data resource
-Eliminate unwanted redundancy
-Improve maintenance of the data resource
DATA ADMINISTRATION TOOLS:
-Data and business models
-Database management systems
-Standards, procedures and naming conventions
-Information Resource Dictionary System
DATA ADMINISTRATION ACTIVITIES:
-Develop data models that document types, resources, uses of data, and relationships between data and business processes
-Develop an IRDS that documents specific format, usage, and location of data
-Standardize data definitions, format, naming and coding
-Develop documentation standards and information security standards

Achieving DA goals requires employing the tools identified in Table 1 as follows:

- Modeling techniques allow the representation of data sources, types, and relationships between data and business processes. A Conceptual Model describes the data and the relationships found in that data. It describes data in terms of objects such as things, policies, and concepts, required to support the business functions of an enterprise. It would, for example, show that an accounts payable process relates to purchase orders, invoices, receipt certification, and payment. A Logical Model represents the required understanding of the data, data relationships, and uses, as viewed by the user. It is a view of the data as used in a particular user environment. It can also provide valuable documentation of the content of a database. A Physical Model describes the physical storage of data, that is the actual data representation employed in the creation of a database or file.

- A Data Base Management System (DBMS) is a software tool that facilitates the management of data and databases. A schema is the definition of the overall logical database structure, i.e., the conceptual model. DBMSs provide different users with different views, or subschemas (or logical models), of the database. To manage the many technical functions associated with complex databases, a Data Base Administrator (DBA) serves as a technical assistant to the Data Administrator. The DBA deals with issues such as:

    - Physical database design/redesign

    - Database creation

    - Database performance monitoring and evaluation

    - Technical procedures

- Standards, procedures, and naming conventions allow standardization of data definitions underlying the information resources of an organization. Standard naming conventions provide a single, consistent vocabulary which users and programmers alike can understand. This allows the MIS staff, for example, to examine and understand which data are being used in procedures, programs, and files.

- The IRDS is a software tool which provides, among other things, data about the data. The IRDS expands the concept that a data dictionary serves as "an organized reference to the data content of the organization" [Ref. 6:p. 51]. The scope of the IRDS encompasses a wider range of information resources than just data, however, including software, hardware, users, and decision models.

The National Bureau of Standards has recently approved the IRDS as an industry standard [Ref. 7]. The IRDS is the Federal Information Processing Standard (FIPS) for data dictionary systems [Ref. 4:p. 1]. A detailed discussion of the IRDS standard follows in Chapter III.

Successful execution of DA activities results from the thorough integration and successful utilization of Data Administration tools. Each activity supports more than one

DA goal. Collectively the activities provide an effective basis for reaching established goals.

D. DA IMPLEMENTATION SUCCESS FACTORS

The literature review identified ten factors applicable to the successful implementation of a Data Administration program. For simplicity, these factors can be grouped into three broad categories: (1) management commitment, (2) management and organizational understanding, and (3) an appropriate DA organization. A discussion of each critical success factor follows below.

1. Full Management Commitment

An organization should not attempt to start a Data Administration program without first securing full management support. DA is an activity which requires the cooperation of all organizational units. Only policies and directives from the highest levels of the organization can provide this type of cooperation. Also, the rewards of good data administration usually do not manifest themselves until 1-2 years after implementation. Therefore, management commitment must be patient and lasting. [Ref. 8:p. 55]

Three explicit actions prove management support: (1) Assignment of an adequate budget for DA; (2) Proper placement of the DA group in the organizational structure; and (3) Public and private DA program support.

In a 1981 survey conducted by Gillenson, 20 percent of the respondents from large system environments felt their DA organizations had inadequate personnel budgets [Ref. 9:p. 705]. Adequate budget support enables the DA group to obtain the resources required to function. Resources include personnel, DA tools (e.g., automated IRDS), and office supplies.

In addition, DA group placement within the organization determines to a large extent its effectiveness. The DA group should be an individual, controlling function, separate from any of the data resource users, so that the organization realizes impartial data resource management. Gillenson found that 40 percent of the respondents with large systems did not place the DA function high enough in the organization. [Ref. 9:p. 699] In another survey conducted in 1982, Kahn reported 64 percent of the responding organizations aligned DA functions directly under the Chief Information Officer [Ref. 5:p. 797]. Figure 1 depicts a suggested placement for the DA function within the corporate environment.

Lastly, management's public and private DA program support is critical for implementing a successful DA program. Public support consists of communicating management's DA commitment through speeches, memoranda, policies, and

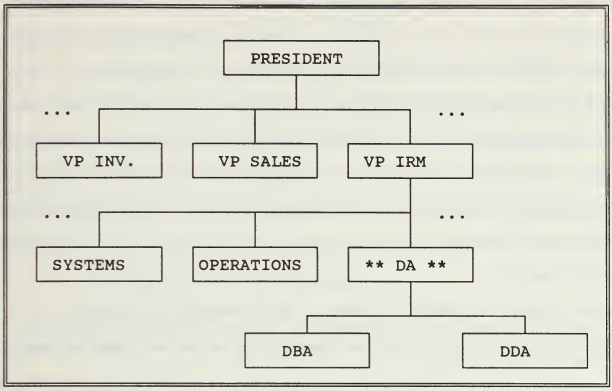

Figure 1. DA Placement In The Organization

directives. Private support involves enforcing policies effectively, and includes the first two factors of DA budgets and organizational placement.

2. Management and Organizational Understanding

Management's understanding of the DA concept and its benefits are essential to implementation success. Kahn [Ref. 5] determined that management's lack of understanding is an inhibitor of successful DA. Equally important is the DA group's comprehension of management's strategic goals.

> In order for the foundation to be laid for the establishment of data...functions, communication between company management and...(DA) should be improved by establishing a common understanding of business strategic plans so...(DA) and company management can develop and implement tactical system plans and data plans [Ref. 8:p. 56].

Relating the benefits of DA directly to the corporate strategic goals can foster a common understanding of DA. Simply stating the traditional benefits of DA, such as more data sharing, more consistent information, increased knowledge of the data available, better systems planning, and reduced costs, will not suffice to convince top management that the DA concept is worthy of their attention. Data plans and systems development efforts must be integrated with business requirements.

> The business benefits sought by a DA policy provide an important contextual framework for associating missions and goals of the organization with those of the policy [Ref. 10:p. 2-4].

Organizational understanding is harder to achieve. The first step is to define clearly DA responsibilities and scope. Creating policies and directives, then ensuring their thorough dissemination, can accomplish this. It helps to include an information architecture in the DA policy. The information architecture introduces a small, but substantial element of "how," which provides a common vision for all data users. [Ref. 10:p. 4-5]

Harder still is convincing people that data, which they once strictly owned, is now shared data. For example, the Sales Manager may no longer exclusively control the data in the sales database. Other departments like Inventory Control can access it for their own purposes. In addition, the implementation of a DA program will cause changes in the

job responsibilities of some people. People resist these changes. [Ref. 9:p. 705]

A thorough DA education and training program can overcome these organizational resistance factors. Support from management, a clear definition of DA responsibilities and scope, and the authority to enforce DA policies form a solid foundation on which to build a DA education and training program.

3. Appropriate DA Organization

Support from top leaders and organizational understanding of the DA concept are but two legs of the triangle of elements needed to introduce a successful DA program. The third leg is the actual staff responsible for DA. Kahn [Ref. 5] found that an insufficient DA staff was another inhibitor of successful DA implementation.

Two components characterize an insufficient DA staff: an inadequate number of employees; and/or employees without adequate knowledge about or experience in DA. Kahn [Ref. 5] found that most organizations assigned four employees to the DA function. Gillenson [Ref. 9] reported large system organizations that considered themselves successful had at least 6-7 employees in the DA function.

A more subtle problem is finding experienced DA personnel. The scarcity of resources caused by the relative newness of the DA discipline significantly hinders the recruitment effort.

Lastly, both Gillenson [Ref. 9] and Kahn [Ref. 5] described DA staff workload as a success factor when implementing DA. The key here is to start small. The DA should apply DA techniques to a single application or system. For example, DA techniques could be applied initially to an inventory control application rather than all program applications. In the process, DA staff can prove DA techniques work, gain staff experience, and build organizational confidence in DA.

Table 2 summarizes the critical factors for successful DA implementation. In Chapter IV we use these success factors to analyze NAVSUP's DA program.

A necessary tool for successful DA implementation is the IRDS. The next chapter discusses the Federal Information Processing Standard for an Information Resource Dictionary System. Modules that comprise the IRDS are discussed, and implementation planning steps are identified.

TABLE 2. CRITICAL SUCCESS FACTORS FOR DA IMPLEMENTATION

I. FULL MANAGEMENT COMMITMENT

a. Sufficient Budget for Necessary Resources
b. Proper DA Placement in the Organization
c. Public and Private DA Program Support

II. MANAGEMENT & ORGANIZATIONAL UNDERSTANDING

a. Relate DA Concept to Business Goals
b. Clearly Define DA Responsibilities & Scope
c. Give DA Authority to Enforce DA Policies
d. Provide Organizational DA Education & Training

III. APPROPRIATE DA ORGANIZATION

a. Adequately Staff DA Organization
b. Knowledgeable and Experienced DA Staff
c. Realistic Workload (Goals) for DA Staff

III. INFORMATION RESOURCE DICTIONARY SYSTEM STANDARD AND IMPLEMENTATION PLANNING

A. INFORMATION RESOURCE DICTIONARY SYSTEM (IRDS)[3]

1. Benefits of an IRDS

A cost-benefit overview was prepared in 1983 for the Institute for Computer Sciences and Technology, National Bureau of Standards. It estimated that the federal government could realize over $120 million (in constant 1983 dollars) in benefits by the early 1990s through use of a standard IRDS. Cost reduction and avoidance opportunities identified included:

- Improved identification of existing information resources made available to others in the same organization or shared with other organizations.
- Reductions of unnecessary development of computer programs when suitable programs already exist.
- Simplified software and data conversion through use of consistent documentation.
- Increased portability of acquired skills resulting in reduced personnel training costs.

In addition to the cost benefits identified, the standard directly supports Data Administration goals through the following:

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[3]Except as noted, the source of information for this IRDS section is "A Technical Overview of the Information Resource Dictionary System (Second Edition)," U.S. Department of Commerce, National Bureau of Standards Publication NBSIR 88-3700, January 1988.

- Aid development, modification, and maintenance of manual and automated systems throughout their life-cycle.

- Support a data element standardization program.

- Support records, reports and forms management, for non-automated through fully automated environments.

2. IRDS Design Objectives

Recognizing that dictionary system technology is evolving and that use of dictionary systems is expanding, three major objectives were identified: [Ref. 11:p. 50]

- The IRDS should contain the major capabilities of existing dictionary systems.

- The IRDS should be modularized to support a wide range of user environments and to support cost-effective procurement.

- The IRDS should support portability of skills and data.

To satisfy the first objective, both federal government representatives and dictionary software vendors reviewed draft versions of the IRDS Specifications. Reviews focused on: (1) functions required by users of their dictionary systems; and (2) the feasibility of carrying out the specified IRDS functions. As a result of these reviews, the IRDS specifications include the most commonly used facilities. It represent a "state-of-the-practice" level of technology.

Designed in modular style, the standard provides flexibility and procurement cost-effectiveness. The Standard includes a "Core" dictionary system Module plus specifications for six additional Modules. All IRDS Modules interface with

the Core Module, although they are independent of one another. Organizations have the flexibility to acquire one or more of the five additional Modules to satisfy their requirements. The Core Module contains a basic set of capabilities described in the paragraphs below.

To provide portability of skills, the Core IRDS Module contains two user interfaces. They are a menu driven "Panel" Interface and a Command Language Interface. The Panel Interface supports interactive processing. It leads users down a structured path of screens (i.e., panels), and accommodates inexperienced users. Thus, technical and non-technical staff can execute IRDS functions with no understanding of the syntax of the Command Language Interface. The Command Language Interface operates in batch or interactive mode.

In support of portability of data an IRD-to-IRD interface exists. An Information Resource Dictionary (IRD) is one application of the IRDS. The IRD-to-IRD interface facility provides a controlled method of moving data from one standard Information Resource Dictionary to another. Organizations using a standard IRDS could, for example, extract data from a decentralized IRD and add it to a central IRD that focuses on corporate-wide data.

3. User's View

The IRDS Standard consists of entities, relationships, and attributes. An entity name corresponds to nouns. Entities

represent or describe a real-world concept, person, event, or quantity, but it is not the actual data. For example, an entity might be Social-Security-Number. An instance of the actual social security number is 555-55-5555. Note that Social-Security-Number is an entity in the IRDS since it describes a data item; however, in the operational database context, Social-Security-Number is an attribute which describes some other entity like Employee. This illustrates the basic difference between the contents of the IRDS and the operational databases which it describes. A relationship name corresponds to verbs. Relationships show an association between two IRD entities. For example, a Payroll-Record "CONTAINS" Social-Security-Number. An attribute name corresponds to adjectives or adverbs. Attributes describe characteristics of an entity or relationship. One attribute of Social-Security-Number is LENGTH, with a value of nine in this example.

Although the IRDS Standard uses entities, relationships, and attributes, it supports alternate approaches to implementation. Any data base management system, using standard DBMS capabilities, can design a software system to implement the Standard. [Ref. 11:p. 55]

An important aspect of the IRDS is that it is strongly typed. Each entity, attribute, or relationship has an entity-type, attribute-type, or relationship-type, respectively [Ref. 11:p. 50]. Entity-type is a label for a set of entities which

have a similar concept and share a set of common attribute-types. For example, in Figure 2 entity-type ELEMENT has as instances the entities Social-Security-Number and Employee-ID. The ELEMENT entity-type has attribute-type LENGTH.

Relationship-type is a label for a set of relationships which have similar meanings and share a set of common attribute-types. In the Relationship-Type RECORD-CONTAINS-ELEMENT shown in Figure 2, the entity-types RECORD and ELEMENT have common attribute-types LENGTH and ALLOWABLE-RANGE.

Attribute-type is a label for a set of attributes which may be common to an entity-type or relationship-type. Figure 2 shows that LENGTH is an attribute-type for the entity-type RECORD, and ALLOWABLE-RANGE is an attribute-group-type for the entity-type ELEMENT.

An attribute-group-type is an ordered set of two or more attribute-types used together. In the example above, ALLOWABLE-RANGE might consist of the attribute-types LOW-OF-RANGE and HIGH-OF-RANGE. The value for LOW-OF-RANGE by itself does not convey clear meaning, so it is grouped with a HIGH-OF-RANGE value.

4. Core Module--Module 1

The Core Module provides basic capabilities as discussed below:

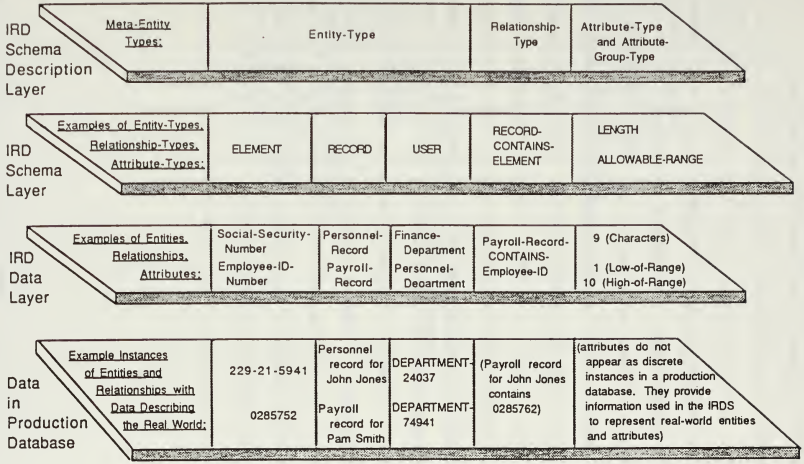

Figure 2. IRDS Content

a. Schema

IRD Schema describes the structure of the IRD. For every entity, relationship, attribute, and attribute-group that exists in the IRD, the IRD Schema contains a corresponding entity-type, relationship-type, attribute-type and attribute-group-type. Metadata describes the structural characteristics of the data [Ref. 4:p. 50]. Therefore, the IRD Schema contains meta-entities, meta-relationships, meta-attributes, and meta-attribute-groups, shown in Figure 2.

The IRDS provides many predefined schema structures. Every implementation of the IRDS includes the Minimal Schema as part of the IRDS Core Module. It contains a set of schema descriptors necessary to establish control over the IRD. A sample Minimal Schema is shown in Table 3. The upper portion of Table 3 identifies types that will control and regulate access to the contents of the IRD and IRD Schema. The lower portion identifies types that will document changes to the IRD and the IRD Schema.[4]

[4]The complete Minimal Schema is listed in Appendix A of "A Technical Overview of Information Resource Dictionary Stystem (Second Edition)," U. S. Department of Commerce, National Bureau of Standards Publication NBSIR 88-3700, January 1988.

TABLE 3. MINIMAL SCHEMA EXAMPLE

To control and regulate access to the contents of the IRD and the IRD Schema:

Entity-Type:

IRDS-USER
IRD-VIEW
IRD-SCHEMA-VIEW

Relationship-Types:

IRDS-USER-HAS-IRD-VIEW
IRDS-USER-HAS-IRD-SCHEMA-VIEW

Attribute-Type:

DEFAULT-VIEW

To automatically document audit information concerning changes to the IRD and the IRD Schema:

Attribute-Types:

ADDED-BY
LAST-MODIFIED-BY
NUMBER-OF-TIMES-MODIFIED

Attribute-Group-Types:

DATE-TIME-ADDED
DATE-TIME-MODIFIED

b. Life-Cycle-Phases

The Core Module includes a life cycle phase facility. This allows an organization to define life-cycle-phases that correspond to the methodology used by the organization. A user documents the life-cycle-phase in which the entity exists, that is, assigns each entity to a life-cycle-phase. Different entities can be associated with, for example, the Requirements Definition Phase, or the Logical Database Design Phase.

The Core Module also includes a life-cycle- phase partition facility. It provides the user with the capability to construct partitions in the IRD that correspond to the life-cycle-phases. Every user operates in an IRD-view, and each IRD-view relates to a partition. Each IRD-partition belongs to one of the following three life-cycle-phase classes:

- Uncontrolled--represents non-operational stages of a system life cycle, such as specification, design, or development.
- Controlled--designed for entities that describe data existing in operational systems.
- Archived--documents entities no longer in use.

Module 4 addresses control of life-cycle management in greater depth.

c. Versioning

A flexible and generalized facility enables users to assign different types of names to an entity. Different

names serve distinct purposes. Understanding the use of and distinction between access-name, descriptive-name, and alternate-name, is basic to understanding the IRDS.

An access-name is the entity's primary identifier. It has two parts: an assigned access-name and a version-identifier. Normally a user will specify the assigned access-name. An option exists to have the IRDS generate the assigned access-name for entities of a given type. A version-identifier consists of two parts--a variation-name and a revision-number. A variation-name is optional, that is, only those entities that have been explicitly assigned variation-names have them. All entities have revision-numbers. Revision-number "1" represents the initial entity before the first revision. For example, the third revision of the statistical module with five digit precision is Stat-Module-(Precision-5:3). The statistical module with eight place precision and no revisions is Stat-Module(Precision-8:1).

A descriptive-name helps non-technical users and managers unfamiliar with the contents of the IRDS. Users assign a descriptive-name, normally longer and more meaningful than the access-name. The structure of the descriptive-name is the same as that of the access-name. It includes an assigned descriptive-name and a version-identifier.

Access-names and descriptive-names must be unique throughout an IRD. The user cannot, for example, have a FILE entity with an access-name Payroll and a RECORD entity with

an access-name Payroll. For those individuals thoroughly familiar with the IRDS, this might seem overly restrictive. That is, it might seem quite reasonable to have a Payroll SYSTEM which accesses the Payroll FILE which consists of Payroll RECORDs. We believe that for those users less familiar with the IRDS, duplication of access-names would cause confusion and unnecessary complication. Besides eliminating potential problems, this feature simplifies Command Language and Panel Interfaces. Except during actual entity creation, the IRDS recognizes the entity-type for every entity name included in a command or panel.

d. Views

The Core provides both IRD-views and IRD-schema-views. A view defines an environment in which a user works with an IRD. An IRD-view includes:

- A set of entities of specified types, with their attributes and attribute-groups. All entities in the IRD-view are in the same partition.
- A set of relationships of specified types, with their attributes and attribute-groups, that exist between the entities.

An IRD-schema-view includes:

- A set of meta-entities, with their meta-attributes and meta-attribute-groups.
- A set of meta-relationships, with associated meta-attributes and meta-attribute-groups, that exist between meta-entities.

5. Basic Functional Schema--Module 2

Module 2 of the Specifications, supports intra- and inter-organization communications about information resources. It defines a "starter set" of entity-types, relationship-types, and attribute-types. The Basic Functional Schema will satisfy most existing and planned manual and automated systems. An organization can augment the Basic Functional Schema using the IRDS extensibility feature.

The Basic Functional Schema contains the eight entity-types shown in Table 4. The relationship-types include most of the connections between Basic Functional entity-types that might prove useful to an organization. Seven predefined relationship-class-types exist for the user. Table 5 lists these. Entity types can be the first and second member of a relationship-type, such as PROGRAM-CONTAINS-MODULE. The relationship-type can also be recursive, for example MODULE-CONTAINS-MODULE.

The Basic Functional Attribute-Types are shown in Table 6. They apply to the entity-types identified in Table 4. For example, attribute-types Classification and Description apply to all entity-types. Ordered sets of attributes are called attribute-groups. They are also included. For example, the attribute-group-type ALLOWABLE-RANGE consists of attribute-types LOW-IN-RANGE and HIGH-IN-RANGE. Attribute-group-type ALLOWABLE-RANGE relates to the single entity-type ELEMENT identified in Table 4.

TABLE 4. BASIC FUNCTIONAL ENTITY-TYPE

1. DOCUMENT: describes instances of human readable data collections, for example, 1988-Annual-Report.

2. ELEMENT: describes instances of data belonging to the organization, for example, Employee-Id.

3. FILE: describes instances of data collections, for example, Payroll-File.

4. MODULE: describes instances of automated processes that are logical subdivisions of PROGRAM entities or independent processes that are called by PROGRAM entities, for example, Sort-Records and Check-Spelling.

5. PROGRAM: describes instances of automated processes, for example, Print-Paychecks.

6. RECORD: describes instances of logically associated data, for example, Payroll-Record.

7. SYSTEM: describes instances of collections of processes and data, for example, Payroll-System.

8. USER: describes individual or organizational component, for example, Comptroller-Department and Jane-Doe.

TABLE 5. BASIC FUNCTIONAL RELATIONSHIP-TYPE

1. CALLS: describes reference associations between PROCESS entities. For example, a CALLS Relationship-type is PROGRAM-CALLS-MODULE, which has as a possible instance Main-Program-CALLS-Sort-Routine.

2. CONTAINS: describes instances of an entity being composed of other entities. For example, a CONTAINS Relationship-type is RECORD-CONTAINS-ELEMENT, which has as a possible instance the relationship Payroll-Record-CONTAINS-Employee Name.

3. DERIVED-FROM: describes associations between entities involving a calculation. For example, a DERIVED-FROM Relationship-type is DOCUMENT-DERIVED-FROM-FILE, which has as a possible instance Annual-Report-DERIVED-FROM-Program-File.

4. GOES-TO: describes flow associations between PROCESS entities. For example, a GOES-TO Relationship-type is PROGRAM-GOES-TO-PROGRAM which has a possible instance the relationship Input-Program-GOES-TO-Processing-Program.

5. PROCESSES: describes associations between PROCESS and DATA entities. For example, a PROCESSES Relationship-type is SYSTEM-PROCESSES-FILE, which has as a possible instance the relationship Budget-System-PROCESSES-Cost-Center-File.

6. RESPONSIBLE-FOR: describes associations between organizational component entities and other entities, denoting organizational responsibility. For example, a RESPONSIBLE-FOR Relationship-type is USER-RESPONSIBLE-FOR-Payroll-System.

7. RUNS: describes associations between USER and PROCESS entities. For example, a RUNS Relationship-type is USER-RUNS-PROGRAM, which has as a possible instance the relationship Jane-Doe-RUNS-System-Backup.

TABLE 6. BASIC FUNCTIONAL ATTRIBUTE-TYPES

ATTRIBUTE TYPE or (ATTRIBUTE-GROUP-TYPE)	ENTITY-TYPE							
	USE	SYS	PGM	MDL	FIL	DOC	REC	ELE
ADDED-BY	S	S	S	S	S	S	S	S
(ALLOWABLE-RANGE)	.	.	.	.	.	.	.	P
LOW-OF-RANGE								
HIGH-OF-RANGE								
ALLOWABLE-VALUE	.	.	.	.	.	.	.	P
CLASSIFICATION	P	P	P	P	P	P	P	P
CODE-LIST-LOCATION	.	.	.	.	.	.	.	P
COMMENTS	S	S	S	S	S	S	S	S
DATA-CLASS	.	.	.	.	.	.	.	S
(DATE-TIME-ADDED)	S	S	S	S	S	S	S	S
SYSTEM-DATE								
SYSTEM-TIME								
(DATE-TIME-LAST-MODIFIED)	S	S	S	S	S	S	S	S
SYSTEM-DATE								
SYSTEM-TIME								
DESCRIPTION	S	S	S	S	S	S	S	S
DOCUMENT-CATEGORY	.	.	.	.	.	S	.	.
(DURATION)	.	S	S	S	.	.	.	.
DURATION-VALUE								
DURATION-TYPE								
EXTERNAL-SECURITY	S	S	S	S	S	S	S	S
(IDENTIFICATION-NAMES)	P	P	P	P	P	P	P	P
ALTERNATE-NAME								
ALTERNATE-NAME-CONTEXT								
LAST-MODIFIED-BY	S	S	S	S	S	S	S	S
LENGTH	.	.	.	.	.	.	.	S
LOCATION	P	P	P	P	P	P	.	.
NUMBER-OF-LINES-OF-CODE	.	.	S	S	.	.	.	.
NUMBER-OF-TIMES-MODIFIED	S	S	S	S	S	S	S	S
NUMBER-OF-RECORDS	.	.	.	.	S	.	.	.
PRECISION	.	.	.	.	.	.	.	S
RECORD-CATEGORY	.	.	.	.	.	.	S	.
SCALE	.	.	.	.	.	.	.	S
SYSTEM-CATEGORY	.	S	.	.	.	.	.	.
USAGE	.	.	.	.	.	.	.	P

S Can have at most a single attribute of the given type

P Can have multiple (plural) attributes of the given type

6. IRDS Security--Module 3

This module defines an access control facility. It allows organizations to restrict access to the IRD and IRD Schema content and functionality. This facility provides two levels of access control:

a. Global Security

Functionality, type, and view combine to define global security. For each IRDS user, one IRDS-USER entity exists. Attributes associated with this entity define thelevel of access, for example, permission to use the Command Language Interface. Associated with each IRD-VIEW and IRD-SCHEMA-VIEW entity are attributes and attribute-groups. They define access for all IRDS users allowed to use the views. This includes read, add, modify and delete permission for each entity-type and meta-entity-type. Each IRDS-USER entity links to those IRD-VIEW and IRD-SCHEMA-VIEW entities through IRDS-USER-HAS-IRD-VIEW and IRDS-USER-HAS-IRD-SCHEMA-VIEW relationships.

b. Entity-Level Security

This facility allows assignment read and write privileges for individual entities. Entity-Level Security allows ten digit number read or write locks, assigned by the system, to each entity requiring security. Users attempting to access a secured entity must have the correct ten digit number key. Only those users granted permission to access an entity secured in this fashion have keys issued to them.

7. Extensible Life-Cycle-Phase Facility--Module 4

This Module extends the life-cycle-phase facilities of the Core Module. It implements integrity rules and controls the movement of entities through the life cycle. As in the core, this module provides life-cycle-phase designation for non-operational, operational, and archived entities. Three additional capabilities include Hierarchical Phase Modeling, Relationship Sensitivity Structures, and Life Cycle Integrity Rules [Ref. 4:p. 33].

a. Hierarchical Phase Modeling

This allows users to designate hierarchical relationship among phases. For example, during development, the Requirements Phase, which might include specification and design phases, is designated as the top of the hierarchy. When the system is operational, the hierarchal model is revised, with the Controlled Phase at the top, and the Requirements Phase beneath.

b. Relationship Sensitivity Structure

This allows users to classify relationships as phase-related. In a phase-related relationship, one entity "depends on" another entity. For example, assume the relationship-type PROGRAM-ACCESSES-SUBROUTINE is phase-related. The first entity in the relationship is dependent on the second entity, while the second entity is independent of the first. The entities of type PROGRAM are dependent on entities of the type SUBROUTINE. To be complete, entities of

type PROGRAM require the presence of entities of type SUBROUTINE.

The phase-related dependency extends to the specific relationships of the relationship-type. For example, in the relationship-type PROGRAM-ACCESSES-SUBROUTINE, the entity PRODUCE-PAYROLL (entity-type PROGRAM) has a phase-related dependency on entity PREPARE-CHECKS (entity-type SUBROUTINE). Phase-related relationship dependencies provide a foundation for the IRDS to enforce life cycle integrity rules.

c. Life Cycle Integrity Rules

Life-cycle integrity rules protect the IRD when moving an entity from an Uncontrolled life-cycle-phase to a Controlled life-cycle-phase, or from a Controlled life-cycle-phase to an Archived life-cycle-phase. Using the Relationship Sensitivity Structure above, independent entities must exist in the Controlled or Archived life-cycle-phase before moving dependent entities to those phases. Using the PROGRAM-ACCESSES-SUBROUTINE example from above, when the user moves PRODUCE-PAYROLL and PREPARE-CHECKS from an Uncontrolled life-cycle-phase to the Controlled phase, the independent entity PREPARE-CHECKS must be in the Controlled phase before the dependent entity PRODUCE-PAYROLL moves there.

8. Procedure Facility--Module 5

This Module provides the user with the ability to define and execute new IRDS procedures, or macros, for IRDS

commands. This allows storage of lengthy commands, can simplify entry of repetitive commands, and allows use of Assignment Statements, DO statements, and IF statements.

9. Application Program Interface--Module 6

The Application Program Interface provides an interface between standard programming languages and the command language of the IRDS. Users can write programs to collect data from, and pass data to, the IRD. The Call feature of the programming language accomplishes the interface. This interface enforces all IRDS integrity and security rules.

10. IRDS Services Interface--Module 7

This Module defines a specific protocol for an interface that will allow software external to an IRDS direct access to the IRD and IRD Schema. The Services Interface uses data structures that are more basic than those used by the Command Language or Panel Interfaces. It is more flexible and potentially more efficient than the Application Program Interface. Examples of external software that could use the provided services are:

- Programming language compilers
- Database query languages like Structured Query Language (SQL) and Network Data Language (NDL)
- Information locator/retrieval systems
- Report writers
- Text editors

Providing external software direct access to the IRD and IRD Schema is significant. It creates an environment that allows the IRDS to be active in an operating environment.

In summary, an Information Resource Dictionary System is a software system that conforms to Federal Information Processing Standards for data dictionary systems. It provides the user a useful, flexible, and extensible system that will support all phases of a system life cycle. The modular structure provides a common set of features in the Core module and in optional modules.

Features in the Core Module include the minimal Schema necessary to establish control over the IRD. The life-cycle-phase facility allows organizations to define life-cycle-phases that correspond with their life-cycle methodology. Versioning enables users to assign different types of names to an entity. Views define the environment in which a user works.

The Basic Functional Schema Module supports intra-and inter-organization communications and defines a starter set of entity-types, relationship-types, and attribute-types. A Security Module provides restricted access, and controls, to the IRD and IRD Schema. The Extensibility Module implements integrity rules and controls entity movement throughout a life-cycle. The Procedure Module allows user-defined macros, and allows use of DO, IF, and Assignment Statements. The Interface Module provides an interface between standard

programming languages and the IRDS Command Language. The Services Module defines a protocol for an interface that will allow direct IRD and IRD Schema access to software external to the IRDS.

Implementing the IRDS standard will benefit any organization. Organizations with multiple IRDS products from different vendors will increase user efficiency, and transportability through the common set of IRDS features. IRDS standards will improve the quality of the data dictionary system by giving users extensibility and life-cycle support, and by giving vendors a common basis from which to work. [Ref. 4:p. 7]

B. IRDS IMPLEMENTATION PLANNING

Every corporate IRDS implementation is unique. The type of IRDS (whether active or passive, dependent or independent), the scope of the IRDS, the organization's information architecture, and the structure of the organization itself contribute to this uniqueness. An IRDS implementation strategy which applies 100 percent to all IRDS implementations does not exist.

However, successful IRDS projects share some common success factors. Together these elements form a sound foundation on which to build an IRDS implementation strategy. In the following sections we describe minimum conditions which

must exist and actions that need to occur before attempting an IRDS implementation.

1. Management Commitment

The condition of management commitment depicted earlier for Data Administration applies here as well. In addition, under public and private program support, management commitment must include: [Ref. 8:p. 55]

- Involvement and support of the corporate information systems planning process.
- Support of a methodology for the design, development and maintenance of information systems. Use of the IRDS in the development process must be mandatory.
- Support of the IRDS as the only source for data definitions in the entire organization.

Management commitment to the implementation of an IRDS is critical for success. Without it, IRDS projects should not start.

2. End User Involvement

The use of the IRDS should benefit the business end users as well as the MIS users. If the IRDS only services MIS user needs, the rest of the organization will not support the IRDS. Include the business end-user wherever possible. For example,

> ...from an administrative point of view, a strong level of understanding and support for the...(IRDS)...is crucial to its success; hence as many persons should participate in its loading and maintenance as can reasonably be accommodated by the system, even if it means sacrificing some quality initially [Ref. 8:p. 59].

Moreover, many potential users may refuse to contribute to the IRDS's implementation effort. Lack of understanding of the IRDS's purpose, fear of change, and the extra effort required to start an IRDS can cause this reluctance. The solution for winning their support is a thorough training program that demonstrates the benefits of using an IRDS, e.g., consistent quality of documentation and improved communication.

3. Coordination and Control

IRDS implementation is a major undertaking which affects many components of the organization. As such, it requires a project manager for centralized coordination and control of the entire project. This IRDS Project Manager needs the authority to coordinate effort across a wide range of organizational boundaries. Therefore, proper Project Manager placement in the organization and project team composition are critical for success. Figure 3 shows a prescriptive example of IRDS Project Manager and team placement within an organization.

The IRDS Project Manager is a senior person with a team consisting of representatives from the various business functions. For example, in Figure 3 TEAM would include key personnel from VP INVENTORY, BP SALES, and VP IRM. When the project is complete, day-to-day operation and maintenance of the IRDS passes to the IRDS Administrator (IRDSA) as indicated by the dashed line in Figure 3.

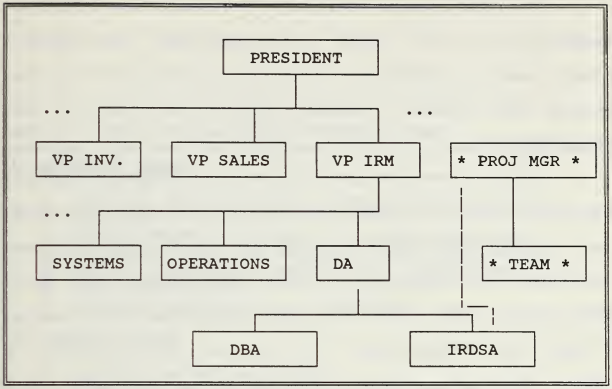

Figure 3. IRDS Project Manager Organization Placement

4. Implementation Plan

An implementation plan provides the framework for guiding all phases of the IRDS implementation. It is the single source for informing all levels of the organization about the project objectives, benefits sought, and a general description of the steps necessary for implementation of the IRDS. The Project Manager is responsible for the Implementation Plan.

> The implementation plan should...gain management commitment, provide a useful service to end users and MIS personnel, have the controls built in to measure the level of its usefulness, and have the required amount of resources, both human and technology, to make the project a success [Ref. 8:p. 114].

The IRDS is part of a larger information architecture designed to meet the needs of the business. The Project Manager should establish a firm relationship in the plan between the strategic Business Objectives and the IRDS implementation.

Table 7 contains the minimum steps a Project Manager should consider when formulating an IRDS implementation plan. Since starting an IRDS is a software project, Table 7 groups the steps into appropriate Systems Development Life Cycle (SDLC) phases [Ref. 12:p. 163]. The steps themselves consist of ideas from Narayan [Ref. 8], Wertz [Ref. 6], Leon-Hong and Plagman [Ref. 13]. These steps are not sequential; many actions within a phase may occur concurrently.

The steps in the Analysis Phase determine the extent of need for the IRDS (steps A through C), the benefits to be gained by its use (steps D and E), and the scope of the IRDS implementation (step F). The Design Phase defines the metastructures of the IRDS (steps A and C), assigns entity ownership (step B), standardizes naming conventions (step D), and selects the appropriate IRDS for the project (steps E and F). Lastly, the Implementation Phase documents the procedures for operating the IRDS (steps A, B, and D), and details the training program for both system users and end users (step C). Here also, the Project Manager should review the plans for implementing applications selected for IRDS use, e.g., how the IRDS will integrate with the SDLC (step E).

TABLE 7. IRDS IMPLEMENTATION PLANNING STEPS

I. **ANALYSIS PHASE**

A. Identify organizational structure and existing practices
B. Review existing systems and system interfaces
C. Interview users and document user requirements
D. Analyze IRDS functions and user requirements
E. Quantify benefits
F. Prepare functional specifications

II. **DESIGN PHASE**

A. Develop entity categories
B. Identify individuals responsible for entity categories
C. Establish attributes and relationships
D. Develop naming conventions for each entity
E. Develop IRDS evaluation criteria
F. Select an IRDS

III. **IMPLEMENTATION PHASE**

A. Develop procedures for populating the IRDS
B. Develop procedures for IRDS update and maintenance
C. Develop a training Package
D. Identify security procedures
E. Outline activities for each application that will be implemented under the IRDS
F. Choose a pilot project

In addition, the Implementation Plan should propose a specific pilot project to prove the value of using an IRDS (step F). A successful pilot implementation will greatly strengthen management and end user support for further application of the IRDS.

To demonstrate control to higher management and engender their support, the Implementation Plan must include the identification of deliverables for each major activity. Furthermore, the plan should estimate resources needed to produce those deliverables and set target dates for each one. Table 8 lists suggested deliverables from each phase.

In Table 8 the Design Phase standards refer to DA functions such as setting naming standards, key word and abbreviation standards, and standards for writing data item definitions. Standards also include the incorporation of IRDS maintenance into the systems development methodology.

The Implementation Phase requires many procedures for the proper operation and maintenance of the IRDS. Table 9 lists some of the procedures the Project Manager should ensure are in place before making the IRDS operational [Ref. 6:p. 275].

In summary, the implementation of an IRDS requires strong management commitment and significant end user involvement. A project manager should coordinate and control the IRDS implementation. He creates and uses the

TABLE 8. IRDS IMPLEMENTATION PLAN DELIVERABLES

I. ANALYSIS PHASE

* A. Revised Information Systems Architecture
* B. Revised IRM strategic planning objectives
C. User requirements
D. IRDS cost/benefit analysis
E. IRDS functional specifications

II. DESIGN PHASE

A. Corporate Data Model
B. Logical Data Model
C. DA Standards
D. Required hardware and operating system software
E. Selected IRDS

III. IMPLEMENTATION PHASE

A. Physical Data Model
B. IRDS installed
C. IRDS populated
D. Procedures
E. Plans for running applications under the IRDS

* Not required if IRDS already included

TABLE 9. IRDS RELATED PROCEDURES

A. Submission and processing of IRDS maintenance
B. Deletion of data that is no longer required
C. Control of back-up files, IRDS restoration and reorganization
D. Monitoring space utilization
E. Control of versions
F. Submission and processing of report requests
G. Audit and correction of IRDS contents
H. Migration of data from IRDS to IRDS and from test status to production
I. Verification of consistency between IRDSs
J. Procedures for changing Standards

implementation plan to win management support and guide the implementation.

The planning steps, deliverables of each implementation phase, standards, and procedures discussed in this section represent minimum requirements for a successful IRDS implementation. These requirements as well as the IRDS standard presented in the first section of this chapter are benchmarks that we will use in the following chapters to gauge the status and extent of NAVSUP's IRDS implementation.

IV. DATA ADMINISTRATION AND IRDS USE AT NAVSUP

An understanding of NAVSUP's information systems environment will help the reader view our findings from a clearer perspective. Therefore, in the next section we describe a "big picture" view of NAVSUP's organization and its strategic directions in IRM. Subsequent sections present the data collection methodology used and the actual findings of the study.

A. NAVSUP ENVIRONMENT[5]

Chapter I briefly described NAVSUP's mission. Figure 4 depicts the NAVSUP command-level organizational structure used to provide supplies and services to its customers worldwide. NAVSUP consists of a Headquarters staff, three Inventory Control Points, eight Navy Supply Centers, four Navy Regional Contracting Centers, and a central design agency (the Fleet Material Support Office). NAVSUP also encompasses the Navy Resale System, the Navy Publishing and Printing Service, and several other field activities supporting special aspects of the NAVSUP mission.

Figure 5 shows the NAVSUP headquarters-level organization. It is important to observe the organization level of the

[5]Unless otherwise indicated, the information for this section comes from the Inventory and Information Systems Development Strategic Plan for FY89 created by NAVSUP 04.

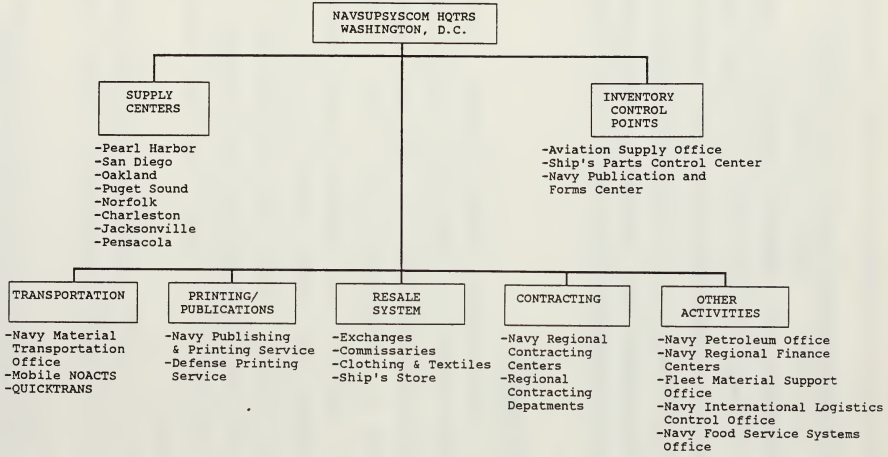

Figure 4. NAVSUP Command-Level Organization [Ref. 1:p. 2-4]

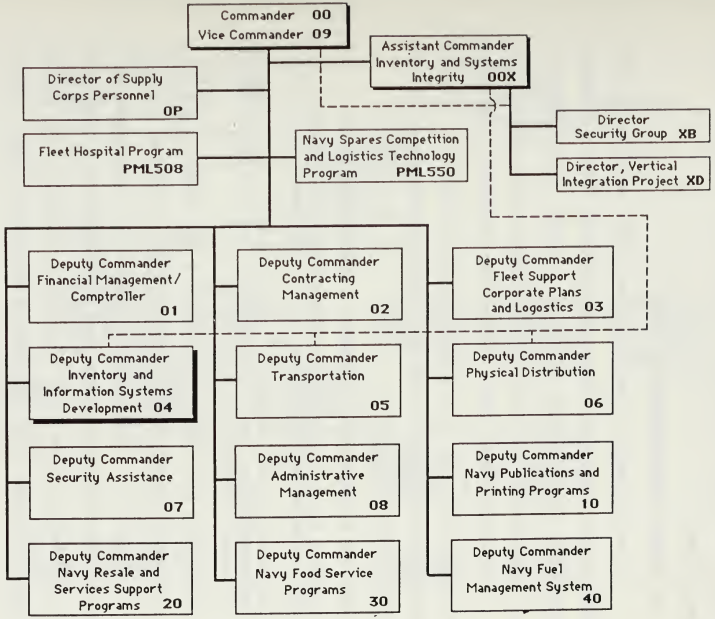
Commander 00
Vice Commander 09
Assistant Commander Inventory and Systems Integrity 00X
Director of Supply Corps Personnel 0P
Director Security Group XB
Fleet Hospital Program PML508
Navy Spares Competition and Logistics Technology Program PML550
Director, Vertical Integration Project XD
Deputy Commander Financial Management/ Comptroller 01
Deputy Commander Contracting Management 02
Deputy Commander Fleet Support Corporate Plans and Logostics 03
Deputy Commander Inventory and Information Systems Development 04
Deputy Commander Transportation 05
Deputy Commander Physical Distribution 06
Deputy Commander Security Assistance 07
Deputy Commander Administrative Management 08
Deputy Commander Navy Publications and Printing Programs 10
Deputy Commander Navy Resale and Services Support Programs 20
Deputy Commander Navy Food Service Programs 30
Deputy Commander Navy Fuel Management System 40

Figure 5. NAVSUP Headquarters-Level Organization [Ref. 1:p. 2-5]

Deputy Commander, Inventory and Information Systems Development (SUP 04) who serves as the Information Resources Manager for NAVSUP, relative to the other functional area Deputy Commanders.

1. NAVSUP Organization for IRM

The Strategic Planning Board (SPB) provides overall direction for NAVSUP business strategy and plans, including information systems (see Figure 6). The SPB consists of Deputy Commanders from all major NAVSUP mission areas.

The Inventory and Information Systems Development Directorate (SUP 04) is the NAVSUP organization for managing information resources. SUP 04's responsibilities include, but are not limited to:[6]

- Serving as NAVSUP's Information Resources Manager.
- Serving as the focal point for interaction on IRM issues with outside organizations, e.g., Congress.
- Directing and managing the design, development, implementation, and maintenance of assigned NAVSUP sponsored information systems.
- Developing and submitting NAVSUP's ADP budget.
- Directing NAVSUP's Data Administration Program.

SUP 04 manages or functionally sponsors approximately 13 military and 71 civilian personnel at Headquarters, and 2,990 field personnel. Also, SUP 04 controls roughly $115 million in Project Funds, $208 million in non-labor costs, and an

[6]For a complete listing of SUP 04's major tasks see Reference 1, page 3-1.

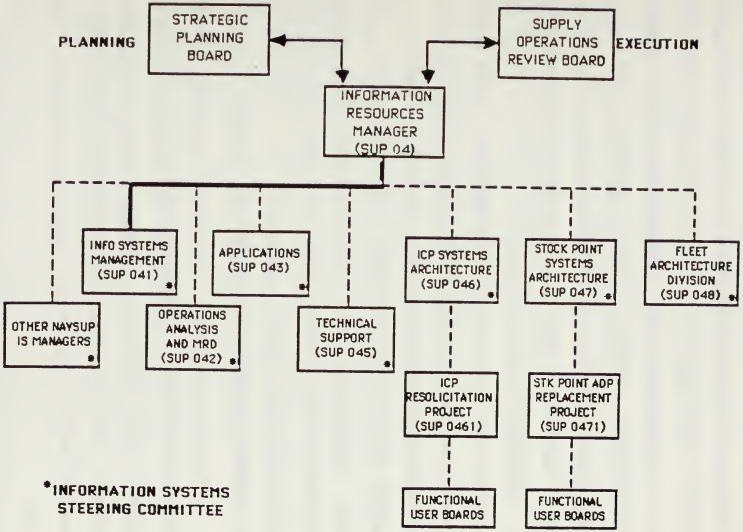
PLANNING
STRATEGIC PLANNING BOARD
SUPPLY OPERATIONS REVIEW BOARD
EXECUTION
INFORMATION RESOURCES MANAGER (SUP 04)
INFO SYSTEMS MANAGEMENT (SUP 041) *
APPLICATIONS (SUP 043) *
ICP SYSTEMS ARCHITECTURE (SUP 046) *
STOCK POINT SYSTEMS ARCHITECTURE (SUP 047) *
FLEET ARCHITECTURE DIVISION (SUP 048) *
OTHER NAVSUP IS MANAGERS *
OPERATIONS ANALYSIS AND MRD (SUP 042) *
TECHNICAL SUPPORT (SUP 045) *
ICP RESOLICITATION PROJECT (SUP 0461)
STK POINT ADP REPLACEMENT PROJECT (SUP 0471)
FUNCTIONAL USER BOARDS
FUNCTIONAL USER BOARDS
*INFORMATION SYSTEMS STEERING COMMITTEE

Figure 6. NAVSUP Organization for IRM [Ref. 1:p 3-6]

information systems budget of $312 million in FY88 projected to $372-400 million in out years.

Seven divisions comprise SUP 04, of which SUP 041, the Information Systems Management Division, is the most relevant to this study. SUP 041's mission is to provide NAVSUP with plans, policies, and guidelines for managing all NAVSUP Information Systems, and to administer ADP Budgets. Also, the Data Administrator function resides within this division. We will discuss the DA organization in greater detail in Section C of this chapter.

Matrix organizations also support IRM. For example, the Information Systems Steering Committee (ISSC) consists of SUP 04, SUP 049 (Assistant Deputy Commander, Inventory and Information Systems Development), and SUP 04 Division Directors, Project Officers, and appropriate functional representatives. The ISSC reviews Information Systems plans and ensures efficient use of resources.

2. NAVSUP Hardware and Software Environment

The current hardware environment includes IBM 3090 large scale mainframes, Burroughs 4700 to 4900 mid-range mainframes, and Interdata, Perkin Elmer and Tandem minicomputers. These systems run automated logistics programs in support of NAVSUP's three tier supply architecture. [Ref. 14:p. 10]

The application software that supports each tier is different. For example, at the top level, two of the

Inventory Control points operate under Uniform Inventory Control Point (UICP) applications. At the middle level, the Stock Points use Uniform Automated Data Processing System for Stock Points (UADPS-SP) applications, while at the bottom level, the ships and squadrons have Shipboard Uniform ADP Systems (SUADPS) applications. [Ref. 15:p. 62]

These systems, along with various office automation systems, share a complex structure of short haul and long haul telecommunication networks. The integration of all telecommunications capabilities is called the NAVSUP Logistic Network (NLN) architecture.[7]

3. NAVSUP Strategic Directions

Three of NAVSUP's strategic directions pertain to this study. The first is the modernization of its key information systems, UICP, UADPS-SP, and SUADPS [Ref. 1: p. 63]. The modernization program's goal is to improve the business functionality, security and integrity of the logistics management systems. Examples of how NAVSUP intends to realize this goal are:

- Replace inadequate, obsolete information technology with appropriate current technology.
- Ensure that the system design fully implements NAVSUP's mission requirements.

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[7]This survey of NAVSUP's hardware and software environment is cursory. For a more thorough description of NAVSUP's Information Systems environment, refer to Reference 1, pages 4-5 through 4-8.

- Ensure that the requirements of each functional end user of the system are met through continuous involvement of end users in the design, development, and implementation process.
- Take full advantage of the productivity gains inherent in modern system design and development tools.
- Ensure that modernization efforts result in improved data integrity, security, and inventory accuracy.

The relevance of these strategic actions will become apparent later in this chapter when we discuss the findings of our study.

The second strategic direction is the explicit declaration to manage information as a resource. To this end the NAVSUP global business model serves as the baseline for reviewing the appropriateness of all information systems actions. It also guides the data administration program in identifying areas requiring further analysis with regard to data and communication architectures, data dictionaries, standardization, and so forth.[8]

The third strategic direction is the emphasis of data integrity and security at each step in the systems development process. As discussed earlier, the discipline of data administration in conjunction with its primary tool, an Information Resources Dictionary System, can contribute significantly to this strategic element.

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[8]To view the NAVSUP Global Business Model see Appendix B, Figure B-1.

4. NAVSUP Information System Architectures

A thorough discussion of NAVSUP's information systems architectures is beyond the scope of this study. However, Appendix B, NAVSUP's Strategic Information System Architectures and Guidelines, provides a useful perspective of: (1) the scope of NAVSUP's effort to gain control of its information resources, and (2) how Data Administration and an IRDS fit into these efforts.

Working within the NAVSUP environment, we employed a combination of methods to collect data. The next sections discuss the data collection methodologies and subsequent data analysis.

B. DATA COLLECTION METHODOLOGIES

We employed two collection methods to gather information about NAVSUP's Data Administration organization, IRDS implementation planning, and IRDS use: (1) interviews, both in person and telephone, and (2) a mail survey conducted under the auspices of the NAVSUP Data Administrator.

The in-person interviews required travel to NAVSUP Headquarters in Crystal City, Virginia and to the Fleet Material Support Office in Mechanicsburg, Pennsylvania. Through the in person interviews, we gained a general understanding of the NAVSUP DA organization while meeting some of the key IRM players. Although we spent most of the time with the NAVSUP and FMSO Data Administrators, and IESC

personnel, we also met with SUP 04 and SUP XD separately to discuss DA and IRDS concepts. Additionally, the in-person interviews provided specific data about DA and IRDS implementation issues and problems. Follow-on telephone interviews with NAVSUP and FMSO Data Administration personnel provided verification of facts and answers to new questions as needed.

The mail survey completed the data collection effort.[9] It provided a broad range of information on Data Administration and IRDS use at NAVSUP and subordinate activities. Questions on the survey required the respondent to answer with one word or check the appropriate block. Short answer type questions, when used, were optional. Also, survey respondents did not have to identify themselves or their activities. This approach encouraged maximum responses and frank comments.

Corporate Data Administration surveys conducted by Gillenson [Ref. 9] in 1981 and Kahn [Ref. 5] in 1982 guided the selection and wording of questions in the survey which covered the following categories:

- General information on Data Administration.
- DA functions and responsibilities.
- Data Dictionary uses.
- DA implementation problems.
- Benefits, perceived or real, gained from DA and IRDS implementation.

[9]See Appendix C for a complete list of questions asked.

Only NAVSUP activities with a Data Administrator assigned received a survey. Seventeen activities met this criterion; of those seventeen, eleven responded (64.7 percent), thus, the survey results do not constitute a scientific sample.

C. DATA ANALYSIS

We categorized the information gained from interviews and the survey under the three primary topics of this study: (1) NAVSUP DA implementation, (2) NAVSUP IRDS implementation planning, and (3) NAVSUP IRDS implementation. A discussion of the data collected under each of these topics follows below.

1. NAVSUP DA Implementation

In this section, we compare NAVSUP's Data Administration program (as defined by the data gathered and presented here) with the critical success factors introduced in Chapter II (refer to Table 2). This comparison results in the identification of DA implementation issues and problems at NAVSUP.

a. Full Management Commitment

Full management commitment consists of three actions: (1) Adequate budget support for DA, (2) DA organizational placement high enough to be effective, and (3) Public and private DA program support by management.

Table 10 shows the NAVSUP Headquarters DA budget for the last four years. While the planned budget calls for

TABLE 10. NAVSUP DA BUDGET

Year	Planned	Actual	Percent *
FY86	No budget	$34,000	
FY87	$314,000	$302,300	96.2%
FY88	$314,000	$202,000	64.3%
FY89	$331,000	$178,000 **	53.8%

* Actual as a % of Planned **Plus $190,000 deferred

a modest 5.4 percent increase in a three year period, the actual DA budget exhibits a significant decreasing trend. Conversations with SUP 041 confirmed that Department of Defense (DOD) budget cuts caused the decline in actual funding. SUP 041 also projected that the deferred $190,000 in FY89 would remain deferred throughout FY89. At a minimum, the current DA budget trend shows that management's immediate priorities do not include DA.

Figure 1 illustrates effective placement of the DA function in an organization. Figure 7 depicts NAVSUP's DA organizational position. NAVSUP's DA resides two layers beneath the Information Resources Manager (SUP 04) and one layer below the organizational entities whose data administration efforts it must coordinate (SUP 041 through SUP 048). Interviews with the NAVSUP DA (SUP 0414) confirmed the frustration of DA goals due to the inability to influence senior organizational groups to cooperate fully with DA

efforts. For example, when scheduling information engineering workshops to support Strategic Data modeling, there was no top management support from those organizational entities involved in NAVSUP's modernization projects. Strategic Data Modeling succeeded through the ability of the NAVSUP DA to obtain required information despite lack of management support [Ref. 15:p. 75].

The last indicator of full management commitment is public and private DA program support. Public support is evidenced through NAVSUP Strategic Plans, publications, and instructions which address the importance of managing data as a resource. However, a significant number of the survey respondents (36 percent) felt that management support was inadequate. In addition, SUP 0414 believed DA lacked sufficient management support.

Based primarily on the budget support and organizational placement of the DA function, we conclude that full management commitment to the implementation of a successful DA program does not exist.

b. Management and Organizational Understanding

Management and organizational understanding is made possible by: (1) relating DA concepts to business goals, (2) defining DA responsibilities and scope, (3) providing the DA with the authority to enforce DA policy, and (4) having a thorough DA education and training program.

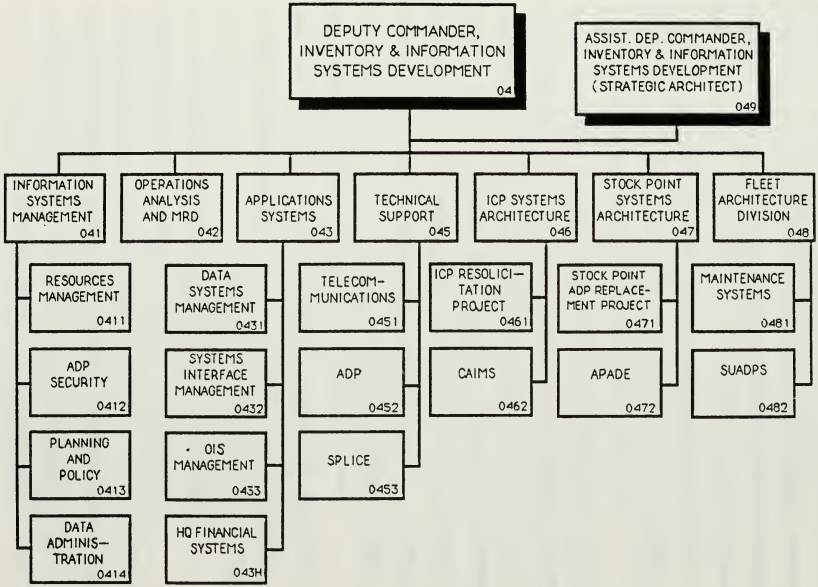

Figure 7. NAVSUP Inventory and Information Systems Development Organization [Ref. 1:p. 3-5]

Figure B-1 of Appendix B depicts the global business model supporting NAVSUP's mission. All information systems architectures must support the functions or processes in this business model. Thus, the business needs of the organization form a solid foundation for NAVSUP's data architecture (Figure B-2, Appendix B).

However, the two primary policy documents for establishing the NAVSUP Data Administration Program, NAVSUP Instruction 5231.1 [Ref. 16] and NAVSUP Instruction 5231.2 [Ref. 17], inadequately relate the DA concept to NAVSUP's business goals. An analysis of these two instructions by American Management Systems, Incorporated in January 1988 revealed the following:

> As stated in NAVSUPINST 5231.1, the objective of the NAVSUP Data Administration Program is to "enhance mission performance through the effective, economic acquisition and use of information." ...However,... policy statements in NAVSUPINST 5231.2 fail to carry this message forward and explicitly state what each policy contributes towards this objective....

Thus the instructions miss an opportunity to establish DA based on a business foundation which would nurture program support from upper management and other organizational groups. [Ref. 18:p. 3-10]

Clearly defining the Data Administrator's responsibilities also promotes understanding. NAVSUP Instruction 5231.1 explicitly defines the roles of the NAVSUP Data Administrator, the FMSO Data Administrator, the Activity Data Administrators, and the Data Administration Advisory

Group. Figure 8 portrays the organizational relationships between these individuals.[10]

Additionally, defining the scope of the DA program is crucial for a proper understanding of it. Although the American Management Systems, Inc. report rightly criticized the lack of defined scope in NAVSUP Instruction 5231.2 [Ref. 10:p. 4-10], SUP 04's Strategic IS Architectures and Guidelines, Appendix B pages 103 through 109, adequately outlines the scope of the DA program.

To effectively implement DA policies the Data Administrator needs the authority to enforce them. Upper management assigns this authority to the DA. However, management must first perceive a need for such authority. A thorough understanding of DA concepts makes management aware of the necessity for this authority to coordinate and control DA efforts.

The survey resulted in 54.4 percent of the respondents replying that the Data Administrator had responsibility without the corresponding authority. Interviews with SUP 0414 reiterated this belief.

Lastly, a thorough DA education and training program is the single most important contributor toward achieving management and organizational understanding of DA.

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[10]For a complete description of responsibilities see NAVSUP Instruction 5231.1, enclosures (3) through (6).

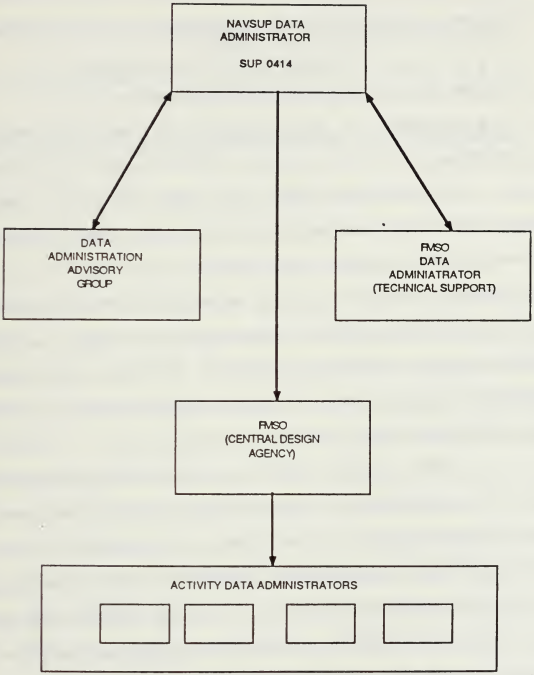

Figure 8. NAVSUP Data Administration Organization [Ref. 15:p. 66]

The survey results confirm the need for education and training:

- 45.5 percent of the survey respondents believed management did not understand DA concepts.
- 36.3 percent of the respondents felt resistance to data sharing by users and systems personnel.
- 54.5 percent of the respondents reported personnel resistance to job responsibility changes caused by new DA policies.

Interviews with SUP 0414 revealed that top managers received a series of executive level briefings on DA. SUP 0414 classified some as disasters, others as effective. The briefers themselves had to adjust the contents and style of the briefs to better suit executive needs. However, despite improved delivery techniques, SUP 0414 still believes management requires more education and training to achieve a full understanding of the need for DA.

The primary vehicle for training and educating subordinate commands is the quarterly meetings of the Data Administrators Advisor Group (DAAG). The DAAG includes all Data Administrators assigned to NAVSUP subordinate activities. For the first and second quarter of FY89, budget constraints forced the cancellation of the DAAG meetings, hence, much needed training did not take place.[11]

In conclusion, we believe NAVSUP's understanding of DA concepts, i.e., management's and the organization's, is

[11]Survey respondents indicated 45.5 percent have conducted some form of DA training at their local commands.

too low for a completely successful implementation of DA. However, the SUP 04 Strategic Plan provides a sound framework from which a better understanding of DA could develop.

c. Appropriate DA Organization

The last of the three critical success factors for DA implementation is an appropriate DA organization. An appropriate DA organization consists of: (1) adequate number of staff, (2) knowledgeable and experienced DA staff, and (3) a realistic workload for the DA staff.

The survey grouped adequate staff and knowledgeable staff into one question. Not surprisingly, a significant number of respondents, 45.5 percent, believed they suffered from a lack of qualified DA staff. Interviews with the SUP 0414 verified the difficulty of recruiting experienced DA staff. Additionally, the current austere budget environment makes it unlikely that NAVSUP DA organizations will achieve necessary manning levels for success.

Interestingly, only two of the eleven respondents had full-time DAs. Two plausible reasons for such a low number of full-time DAs are: (1) field activities simply have not acquired the budget resources necessary to support full-time DAs; or (2) field activities do not perceive the need for a full-time DA.

Significantly though, one of the full-time DAs believed that DA workloads were too heavy. The workload of the DA staff must match their capabilities. Initial goals

should be small and achievable. This builds staff experience, proves DA works, and builds organizational confidence in DA. A pilot project approach works well here. Interviews with SUP 0414 confirmed the need to identify a pilot project to prove DA concepts work. However, as yet, SUP 0414 does not have a pilot project assigned.

Thus, based on our findings, we believe that NAVSUP's DA organization suffers from a lack of qualified staff and an unbalanced workload. Successful DA program implementation depends on a combination of NAVSUP's ability to attract and retain qualified DA personnel, and to assign realistic workloads to achieve DA goals.

In summary, the three critical success factors for DA implementation are (1) full management commitment, (2) management and organizational understanding, and (3) an appropriate DA organization. Currently, full management commitment to DA implementation does not exist. Also, NAVSUP has not achieved a sufficient level of management and organizational understanding of DA. Lastly, we concluded that NAVSUP does not have the appropriate DA organization in place. We believe successful DA implementation under these conditions is not feasible.

2. NAVSUP IRDS Implementation Planning

NAVSUP refers to their IRDS as the Information Resources Data Dictionary/Directory (IRDD/D). The terms IRDS

and IRDD/D are synonymous. The last section in this chapter presents the differences between the IRDS standard discussed in Chapter III and NAVSUP's IRDD/D.

Here we compare the four common success factors for IRDS implementation planning established in Chapter III with the data obtained about NAVSUP's corporate level IRDS project. The four success factors are: (1) management commitment, (2) end user involvement, (3) coordination and control, and (4) an implementation plan.

a. Management Commitment

Two components of management commitment, budget support and program support (both public and private), discussed earlier under DA apply here as well. The third, proper organizational placement falls under the coordination and control success factor.

IESC is currently working under a NAVSUP contract to complete the operational logical data model. Thus, budget support for the IRDD/D implementation project is adequate through the logical data model deliverable of the design phase (see Table 8). Since NAVSUP anticipates completing the operational logical data model design in the last quarter of FY89, funding for the physical database design and IRDD/D implementation will most likely fall under the FY90 budget. However, the high probability of further budget cuts in FY90 is a real threat to the project's continuance.

Management support for the IRDD/D project is apparent from the NAVSUP strategic directions discussed earlier in this chapter. An IRDD/D is the key to attaining all three strategic goals. Furthermore, the frequent appearance of the IRDD/D in SUP 04's Strategic Plan under the guise of "Corporate Data Dictionary" (CDD) emphasizes management's acceptance and support of the IRDS concept. The Strategic Plan calls for the use of the IRDD/D as the authoritative source of data definitions for all new information systems projects.

However, other circumstances exist which mitigate this support. For example, management support of a methodology for the design, development, and maintenance of information systems with the mandatory use of an IRDS is critical for successful IRDS implementation. Unfortunately, the modernization of NAVSUP's major automated systems began before DA and the IRDS concept existed at NAVSUP. Retrofitting DA techniques and the IRDD/D to these major projects is expensive, extremely complex and time consuming. Not surprisingly, project managers resist any activities that may cause a slip in a major milestone. Interviews with Sup 0414 confirmed this resistance significantly hindered initial acceptance and support for the IRDD/D project.

Despite this resistance, we believe that NAVSUP management commitment to the IRDD/D concept is strong. However, NAVSUP management commitment to the IRDD/D

implementation is at a critical crossroad. The continued funding of the project will ultimately reflect the extent of management's commitment.

b. End User Involvement

End user involvement includes three components: (1) the IRDS must benefit the business end user, (2) the business end user should participate in the creation of the IRDS, and (3) an end user training program should strive to overcome fear of change, lack of understanding, and promote end user benefits.

The NAVSUP IRDD/D will derive its existence from the NAVSUP Global Business Model and the logical data model. The Global Business Model contains the processes and functions of the business as defined by the business end user. The IRDD/D benefits the end user by supporting these processes and functions. For example, a business end user desiring to know what a requisition number is, its composition, and what processes and functions use it, could query the IRDD/D to obtain this information.

As stated earlier in this chapter, the continuous involvement of end users in the design, development, and implementation process will ensure that the IRDD/D meets end user requirements. Interviews with IESC personnel and SUP 0414 indicate that NAVSUP functional users have thus far participated in every step of the IRDD/D project.

What is not clear, though, is the depth of end user involvement. We found no signs of a formal training program to disperse general knowledge of the IRDD/D's purpose, use, and benefits to large numbers of functional end users. Although the IRDD/D is still in the design phase, it is not too early to plan the preliminary details of a training program.

We believe the level of end user involvement in the IRDD/D project thus far is sufficient. Continued end user involvement in the implementation and maintenance stages is critical for the ultimate success of the IRDD/D project. A well constructed training program can encourage this end user involvement.

c. Coordination and Control

The successful implementation of an IRDS depends on proper project coordination and control. The three critical elements are: (1) the right project manager, (2) project team composition, and (3) project team organizational placement.

SUP 0414 serves as the project manager for the IRDD/D implementation. The project team consists of IESC personnel, the DA support staff, and working groups from each of the functional areas. The team reports to SUP 041.

Interviews with SUP 0414 and other project team members indicate that they lack the influence with the Deputy Commanders to effectively coordinate the project (refer to

Figure 5). This situation is similar to that of Data Administration organizational placement discussed previously in this chapter.

We believe the project manager's lack of seniority and the project team's low organizational placement significantly decrease their political clout. Adequate political influence is necessary for coordination and control across all functional areas at the directorate level. This situation hinders the implementation of NAVSUP's IRDD/D.

d. Implementation Plan

An implementation plan, as described in Chapter III, covers a broad area of planning activities necessary for guiding all phases of the IRDS implementation. Interviews with SUP 0414 and other DA staff members revealed that a comprehensive IRDS implementation plan (in the format recommended in Chapter III) does not exist. This makes direct comparisons impractical. Therefore, we present a comparison of Chapter III's IRDS implementation planning steps and deliverables with identifiable actions taken by NAVSUP to date.

The first goal of the IRDS Implementation Plan is to relate the IRDS implementation to strategic business objectives. As stated previously, SUP 04's Strategic Plan does this adequately.

Next, the IRDS Implementation Plan should outline the planning steps and deliverables for each SDLC phase (refer

to Table 7). The Analysis Phase establishes: (1) the extent of need for the IRDS, (2) the benefits gained from its use, and (3) the scope of the IRDS. NAVSUP completed steps A through D and step F of the Analysis Phase in Table 7 by two actions. First, the study by AMS, Inc. established the need for the IRDS, described its benefits, and identified the requirement to define its scope [Ref. 10:p. 1-1 and 1-2; Ref. 20:p. 4-3]. Second, subsequent efforts by the NAVSUP DA, IESC, and NAVSUP functional area representatives completed these steps [Ref. 15:p. 76].

However, no documentation exists supporting the completion of quantifying benefits (step E). This is a difficult step, but one which can garner management support for the project if done correctly.

NAVSUP is currently in the design phase of the IRDS implementation. Interviews with IESC personnel and the NAVSUP DA staff confirmed that steps A through D of the design phase are part of the design effort to complete the operational logical data model. Plans to develop IRDS evaluation criteria (step E) and select an IRDS (step F) do not exist.

Furthermore, under the implementation phase, we found no documented plans for populating the IRDS (step A), IRDS update and maintenance (step B), training package (step C), and security procedures (step D). Conversations with SUP 0414 indicated an awareness of the need for such plans.

However, low staffing levels prevented their creation before the implementation phase.

Lastly, the current contract with IESC, which includes creation of procedure models for application systems, covers step E. Also, as stated previously, NAVSUP has not identified a pilot project (step F).

The implementation plan should also include the deliverables in each phase identified in Table 8. Under the Analysis Phase, NAVSUP's Information Systems Architecture and IRM Strategic Plan already include the IRDD/D (alias the CDD) as part of NAVSUP's overall planning objectives. User requirements (deliverable C) and IRDS functional specifications (deliverable E) resulted from the efforts described above concerning the Analysis Phase steps. However, we found no indication of an IRDS cost/benefit analysis.

Under the Design Phase, IESC completed the Corporate Data Model. Currently, they are working on the Operational Logical Data Model scheduled for completion by June 1989. DA standards (deliverable C) exist to a limited extent in NAVSUP Publication 509, (Official Title), which deals with data naming conventions. However, SUP 0414 and DA staff report NAVSUP Publication 509 needs a significant revision to bring it up to date.

Only two other deliverables have been planned, and those only partially. NAVSUP contracted IESC to create the specifications of physical data characteristics. These

specifications will be the foundation for the Physical Data Model, deliverable A under the Implementation Phase. Also, IESC is to create procedure models for application systems. These procedure models are part of the plans for running applications under the IRDD/D, deliverable E of the Implementation Phase.

In summary, NAVSUP has achieved many of the IRDS implementation steps and deliverables outlined in Chapter III, despite not having a comprehensive IRDS Implementation Plan. However, we believe the lack of a comprehensive IRDS implementation plan significantly jeopardizes the IRDD/D implementation.

Without such a plan, directly linking the IRDD/D to business objectives and demonstrating project control to management is difficult at best. This situation does not engender management support for the project. Lack of management support partially explains the low organizational placement of the IRDS project team and the unstable funding environment for the project.

Additionally, without a framework for guiding all phases of the IRDS implementation, there is always the danger of overlooking a critical step in the development process. Such an oversight can create serious unforeseen problems later.

The next section compares the major concepts of the NBS IRDS standard with the design of the IRDD/D.

3. NAVSUP IRDD/D Implementation

As stated in the NAVSUP Strategic Plan, NAVSUP must remain in a position to take advantage of modern information technology such as: [Ref 1:p. 6-9]

- Data and processing distribution.
- The growing power and efficiency of relational data base technology.
- Intelligent work stations (IWS) in the hands of end users throughout the supply system including managers and executives.
- Intelligent network capabilities.
- Artificial intelligence.

In support of this, NAVSUP operates a logical three-tier information processing architecture. The three tiers are: Production, Departmental, and End User. Table 11 provides examples of data and applications to be resident in the three-tier architecture.

Three conceptual views of the CDD are near term, mid term, and long term. In the near term, the current NAVSUP state, the IRDD/D will interface with the existing Modernization Reference Dictionary (MODDICT), as shown in Figure 9. We discuss MODDICT in more detail later in this chapter. The IRDD/D interacts with MODDICT in the Production Environment only. As Table 11 shows, shared data is centrally managed and maintained.

In the mid term, the IRDD/D interfaces with the Production Environment and the DSS environment, Figure 10. At this stage, applications include ad hoc query and transaction preparation.

The long term concept, Figure 11, shows the CDD and its interaction with all levels of the three tier architecture. Applications include Decision Support Systems for the End User, and transaction and documentation preparation.

TABLE 11. THREE-TIER ARCHITECTURE [Ref. 1:p. 6-9]

TIER	TYPE DATA	TYPE APPLICATION
Production	-Corporate shared raw data -Data derived for production -Historical data	-Data establishment and change -Centrally managed and maintained -Process carried to logical conclusion
Departmental	-Corporate download augmented with additional/derived data	-Data use/manipulation -Transaction preparation -Ad hoc query represents process controls -Document storage distribution
End User	-Specialized download -Derived data -Personal data	-Decision support systems -Transaction and documentation preparation

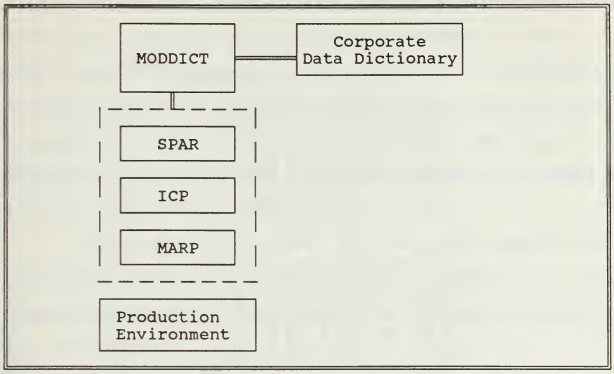

Figure 9. Near Term Concept

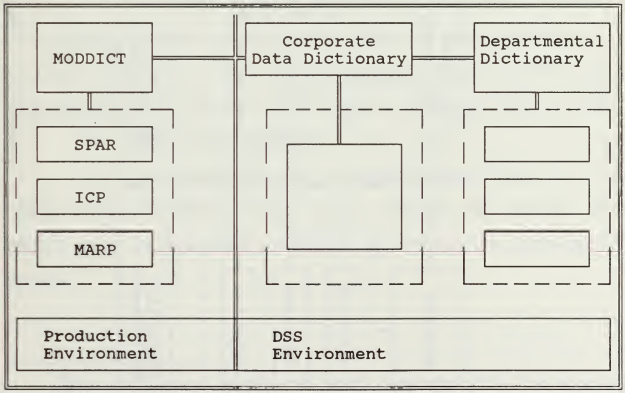

Figure 10. Mid Term Concept

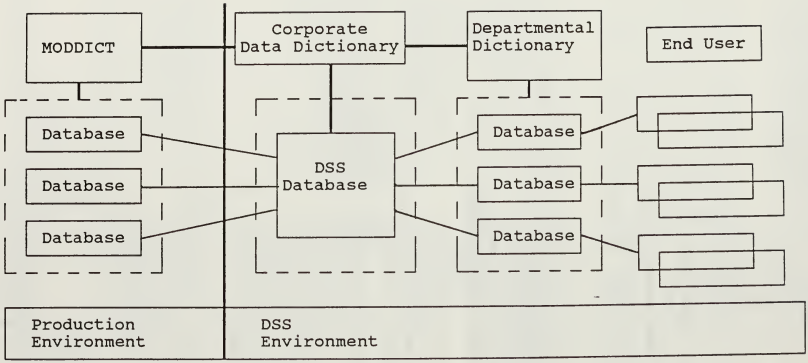

Figure 11. Long Term Concept

An existing contract with IESC provides a continuing effort that supports the development of NAVSUP's IRDD/D. In 1988, American Management Systems (AMS), Inc. published the results of a detailed study of NAVSUP's CDD requirements and alternatives [Ref. 18:p. 3-1]. Custom development of dictionary software was the alternative selected by NAVSUP to satisfy its IRDD/D requirements.

Chapter III discussed the recently approved NBS Information Resource Dictionary System standard. We will compare development of the NAVSUP IRDD/D with key concepts of the NBS standard.[12]

1. Core Module

a. Schema

The IRDD/D will include the ability to control and regulate access to the IRDD/D and the IRDD/D Schema. It will not include a facility to automatically document audit information about changes to the IRDD/D and the IRDD/D Schema.

b. Life-Cycle-Phases

The capability to construct partitions in the IRDD/D that correspond to life-cycle-phases will exist. The IRDD/D will include the potential to categorize life-cycle-phases.

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[12]The comparison of the NBS IRDS features with the ongoing design of NAVSUP's IRDD is based on a series of telephone interviews with George Miller, SUP 04142, and Francis Barnett, Consultant, IESC representative, during February 1989.

c. Versioning

A facility to assign different types of names will exist. Primary identifiers will have version-identifiers. Version-identifiers can consist of a variation-name and a revision-number. The IRDD/D will allow descriptive-names. It will allow duplicate access-names and descriptive-names throughout the IRDD/D.

d. Views

A facility to define IRDD/D-views and IRDD/D-schema-views will exist. An IRDD/D-schema-view will include a set of meta-entities, meta-attributes, and meta-associations.

2. Basic Functional Schema

There will be no defined Basic Functional Schema in the IRDD/D, however, defined entities, attributes, and associations will be more comprehensive. The IRDS "starter sets" will be subsets of IRDD/D defined entities, attributes, and associations.

3. IRDS Security

The IRDD/D will contain an access control facility. Create, Read, Update, and Delete (CRUD) values will define the access level to the IRDD/D and IRDD/D Schema. There will be no separate Entity-Level Security as read or write locks for individual entities.

4. Extensible Life-Cycle-Phase Facility

The IRDD/D will not include the ability to designate hierarchical relationships among phases. Phase-related associations, where the first entity in the association is dependent on the second entity, while the second entity is independent of the first, will exist. Integrity rules for moving an entity between life-cycle phases will exist.

5. Procedure Facility

The capability to define and execute IRDD/D procedures, or macros will not exist.

6. Application Program Interface

An interface between standard programming languages and the command language of the IRDD/D will exist. A facility will exist to enforce integrity and security rules.

7. Services Interface

The initial version of the IRDD/D will not contain this feature. Future versions will allow external software direct access to the IRDD/D and IRDD/D Schema.

Many features of the NBS IRDS standard are currently being incorporated in the design of the NAVSUP IRDD/D. Significant IRDD/D features that differ from the IRDS standard include:

- The inability to automatically document audit information concerning changes to the IRDD/D and IRDD/D schema.
- The ability to duplicate access-name and descriptive-names throughout the IRDD/D.
- The inability to designate hierarchical relationships among life-cycle-phases.

- The inability to define and execute IRDD/D procedures or macros.

While NAVSUP develops the IRDD/D, NAVSUP's Central Design Agency, FMSO, continues to improve MODDICT. MODDICT also known as NAVSUP PUB 562, is the FMSO command dictionary. It is the central reference source for data about NAVSUP developed systems. It includes only data from modernized systems. MODDICT contains data elements extracted from multiple logical design dictionaries such as SPAR, UICP, and MARP. Initial population occurs when logical design dictionaries export data elements and their characteristics to MODDICT. [Ref. 19:p. 2-1]

MODDICT serves as one of the tools used by system developers. There exists a draft Requirements Statement for MODDICT expansion. The draft provides a communications vehicle for FMSO system developers and end users to review the requirements for expansion. The draft expansion includes a requirement to structure MODDICT to conform to the NBS IRDS standards. [Ref. 19:p. 2-2]

MODDICT plays an important role for system designers at FMSO. Structuring MODDICT to conform to the NBS IRDS standard will assist in eventual IRDD/D implementation. We believe that the design of the NAVSUP IRDD/D should conform to the NBS IRDS standard in all respects. Though the NBS standard is not mandatory, "Turnkey Systems" traditionally conform to the standards. It is doubtful that an

organization as complex as NAVSUP will ever operate under one software environment. Designing a corporate tool that will interface with numerous vendor products will help ease future interface problems.

In the next chapter, we present solutions and guidelines for the resolution of the problems identified in the study.

V. RECOMMENDATIONS AND CONCLUSIONS

In this study, we used a three pronged approach for analyzing a subset of the IRM infrastructure at NAVSUP. Specifically, we studied NAVSUP's: (1) implementation of DA, (2) IRDS implementation planning, and (3) actual IRDS implementation. The study identified problems and issues hindering successful implementation of this IRM subset at NAVSUP. Below, we summarize these problems and issues, and offer recommendations to resolve the most significant ones.

A. NAVSUP DA IMPLEMENTATION ISSUES AND RECOMMENDATIONS

Full management commitment, management and organizational understanding of DA concepts, and a strong DA organization form the foundation of a sound Data Administration program. Our study results show that the NAVSUP DA program is weak in each of these areas.

The key to successful DA implementation is management understanding of DA concepts. Management understanding paves the way for management commitment. Management commitment makes a strong DA organization possible by allocating sufficient resources to support the DA program. Therefore, we recommend that NAVSUP do the following:

- The NAVSUP Strategic Plan, NAVSUP Instruction 5231.1 and NAVSUP Instruction 5231.2 should use the same terms and acronyms to describe the DA program. Each document should support the other in establishing links between DA concepts and the business goals of the organization.

Consistent use of terms and a strong orientation toward business goals will foster management and organizational understanding of DA concepts.

- The Data Administration Advisory Group (DAAG) meetings are an excellent vehicle for expanding the organization's level of awareness of DA concepts, issues, and problems. Organizational DA awareness is an education process which can take several years to obtain. Since NAVSUP is in the early stages of establishing a DA program, now is the right time to start the education process. NAVSUP should not wait until major systems requiring DA skills are on-line before developing the necessary DA awareness and skills to manage them, e.g., SPAR. By then, it will be too late.

- The DA group must exist on an organizational level where it can effectively coordinate DA efforts across all organizational boundaries. At a minimum, NAVSUP's DA group should report directly to SUP 04. The Data Administrator should be a GS-15. Under this arrangement, SUP 04 would provide the political influence to seek support for the DA program from the other directorates.

- As a minimum, the DA budget should adequately support the DA staff, the creation of a DA education and training program, the DAAG quarterly meetings, and the creation and implementation of the IRDD/D.

B. NAVSUP IRDS IMPLEMENTATION PLANNING ISSUES AND RECOMMENDATIONS

Successful IRDS implementation planning requires four elements: (1) management commitment, (2) end user involvement, (3) project coordination and control, and (4) an implementation plan. Study results indicate the first two elements are adequate at NAVSUP for the IRDS implementation (assuming continued budget support). However, the third element is significantly frail and the fourth element non-existent. We recommend NAVSUP take the following actions:

- The implementation of an IRDS requires assimilated knowledge and coordination from all areas of the

organization. We believe a matrix organization[13] is the best structure for the IRDD/D implementation team. A matrix organization is an excellent mechanism for undertaking and accomplishing complex projects. Such a structure stimulates interdisciplinary cooperation and motivates people to identify with the end product. [Ref. 21:p. 254-255] The Project Manager should have a functional background to ensure the IRDD/D meets NAVSUP's mission needs. He/she should be a GS-15 or mid-grade O-6 who reports directly to SUP 00X.

- In addition, the Project Manager should have two assistants: the NAVSUP DA for data administration expertise and the DBA from the IRDD/D implementation site for technical proficiency. This management group should draw its team from the DA staff, private contractor, and representatives from each functional area.

- The IRDD/D implementation Project Manager should create a comprehensive Implementation Plan. The plan should outline the tasks and specify the deliverables of each phase of the SDLC. Moreover, the plan should relate the IRDD/D project directly to NAVSUP's business plans and mission needs. In addition, SUP 00 should approve the plan.

C. NAVSUP IRDD/D IMPLEMENTATION ISSUES AND RECOMMENDATIONS

The IRDD/D is at the pinnacle of a planned hierarchy of dictionaries that will exist to support NAVSUP's three tier information systems architecture (refer to Figure B-3, Appendix B). The success of this architecture hinges on each dictionary's ability to communicate with the dictionaries on the other levels.

Currently, IESC is designing a generic IRDD/D. Implementation of this generic IRDD/D could occur under most

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[13]A matrix organization is an organizational structure in which each employee reports to both a functional manager and a project manager. [Ref. 21:pp. 251-255] provides a more thorough description of a matrix organization.

relational DBMSs, e.g., DB2 or Oracle. We recommend that the design and implementation of the IRDD/D adhere to the IRDS standard presented in Chapter III for the following reason: NAVSUP's information systems architecture consists of diverse, geographically dispersed systems. No IRDS exists now which is compatible with all of NAVSUP's information systems.

However, the NBS IRDS Standard establishes the framework for the creation of such an IRDS. Since commercial vendors participated heavily in the formulation of the NBS IRDS Standard, we believe it is only a matter of time (2-4 years) before a commercial product reaches the market that can meet NAVSUP's environmental needs.

D. CONCLUSIONS AND AREAS FOR FURTHER RESEARCH

1. Conclusions

While viewing the extent and depth of DA and IRDS use at NAVSUP and its subordinate commands, one implementation factor continually stood out: organizational change. As discussed previously, DA is a relatively new management discipline compared to areas such as finance or inventory, and, IRM is even more recent. Historical information to guide IRM and DA implementation is scant. However, we believe two points are clear from the evolution of IRM and DA. First, organizations must view information as a resource requiring

management. Second, structural changes to the organization are necessary to implement the infrastructure needed to support the management of information.

This study furnished evidence of NAVSUP's plan to manage information as a resource. In addition, it provided suggestions for creating the infrastructure to support a subset of IRM at NAVSUP, specifically DA and the use of an IRDS. This study also offered guidelines for the implementation of a DA program, planning an IRDS implementation, and establishing an IRDS.

2. Areas for Further Research

During the course of this study, we identified three areas of interest which require further research. First, NAVSUP's target information systems architecture calls for a hierarchy of data dictionaries. The physical implementation details for such a hierarchy do not currently exist. Part of the reason for this is the technology lag in IRDSs discussed earlier. A future study could track the progress of IRDS technology and propose or design the actual physical implementation of NAVSUP's IRDS hierarchy.

Second, the long term question of whether NAVSUP should implement an active IRDD/D versus the passive IRDD/D could be addressed. Further research could establish appropriate criteria for the determination of which IRDSs in NAVSUP's IRDS hierarchy should be active and which should be passive. An additional objective of such a study could be to

develop a strategy for converting passive IRDSs to active IRDSs.

Third, NAVSUP information systems must have the capability to communicate with other NAVY and DOD components. A future study could address the issue of how NAVSUP's IRDD/D will interface with outside information systems.

APPENDIX A

LIST OF ABBREVIATIONS

ADP	Automated Data Processing
AMS	American Management System, Inc.
CDD	Corporate Data Dictionary
CRUD	Create, Read, Update, Delete
DA	Data Administration
DAAG	Data Administrators Advisor Group
DBA	Data Base Administrator
DBMS	Data Base Management System
DOD	Department of Defense
DSS	Decision Support System
FIPS	Federal Information Processing Standard
FMSO	Fleet Material Support Office
ICP	Inventory Control Point
IESC	Information Engineering Systems Corporation
IRD	Information Resource Dictionary
IRDD/D	Information Resource Data Dictionary/Directory
IRDS	Information Resource Dictionary System
IRDSA	IRDS Administrator
IRM	Information Resource Management
IS	Information System
ISSC	Information Systems Steering Committee
IWS	Intelligent Work Stations

MARP	Missile ADP Replacement Program
MIS	Management Information System
MODDICT	Modernization Reference Dictionary
NAVFSSO	Navy Food Service Systems Office
NAVSUP	Naval Supply Systems Command
NBS	National Bureau of Standards
NDL	Network Data Language
NLN	NAVSUP Logistic Network
NSC	Naval Supply Center
PRA	Paperwork Reduction Act
SDLC	Systems Development Life Cycle
SPAR	Stock Point ADP Replacement
SPB	Strategic Planning Board
SQL	Structured Query Language
SUADPS	Shipboard Uniform ADP systems
SUP XD	Director, Vertical Integration Project
SUP 00	Commander, Naval Supply Systems Command
SUP 00X	Assistant Commander, Inventory and Systems Integrity
SUP 04	Deputy Commander, Inventory and Information Systems Development
SUP 0414	NAVSUP Data Administrator
SUP 049	Assistant Deputy Commander, Inventory and Information Systems Development
UADPS-SP	Uniform Automated Data Processing System for Stock Points
UICP	Uniform Inventory Control Point

VI. STRATEGIC INFORMATION SYSTEM ARCHITECTURES AND GUIDELINES

This section of NAVSUP's plan provides the bridge between the business-type, management-by-objectives discipline contained in the preceding sections and the technical aspects of information systems planning required for systems development that follows in section VII.

Much of the conceptual framework for this section of the plan comes from an article by Devlin and Murphy in the IBM Systems Journal, Vol 27, No 1, 1988. Figure 1 is the overall Information System Architecture that forms the basis of our information systems planning and provides a rational envelope within which to develop coordinated, supportive information systems.

The uppermost level of figure 1 includes the NAVSUP Strategic Plan and the DON Information Resources Strategic Plan, which includes the Functional Sponsors' Plans, and provides overall business and information resources management strategies.

The next three levels of the overall architecture are discussed in detail beginning with paragraph A, below. Each Information Processing Architecture is accompanied by Guidelines to be used for information systems development and thereby achieve a cohesive organization of systems.

The last level of the overall architecture is reflected in Section VII, Information Requirements Plans beginning on page 7-1.

A. INFORMATION SYSTEMS STRATEGIES

This paragraph discusses the three information system strategies shown in the second level of the overall Information System Architecture, figure 1.

1. BUSINESS MODEL AND INFORMATION FLOW

The Chief of Naval Operations designated the Commander, Naval Supply Systems Command as the steward for supply functions throughout the Navy. Supply is pervasive. Virtually every organization within the Navy, as well as many contractors, perform some level or aspect of supply.

a. NAVSUP'S mission is to develop, manage and operate the Navy Supply System to provide supplies and services to satisfy peacetime and wartime fleet and other customer mission requirements (source: NAVSUP STRATEGIC PLAN).

b. Business process and information architectures or models are required for understanding the business functions and the information required to support that mission and are the logical starting point for information systems technical planning.

OVERALL INFORMATION SYSTEM ARCHITECTURE

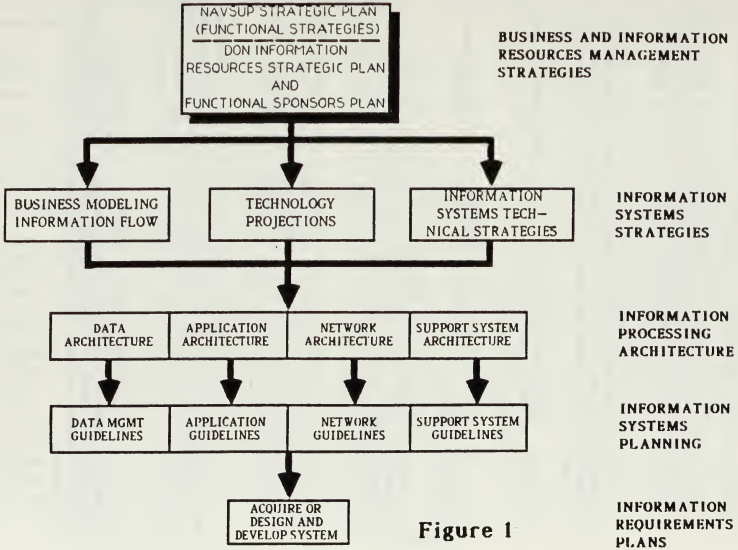


Figure 1

(1) The business model supporting NAVSUP's mission is depicted by figure 2. Supply macro function definitions are contained in appendix A.

(2) The strategic information categories required by supply functions are shown by figure 3.

c. The hierarchy of effort in the business model is: Mission, Function, Process, and Activity/Task. The intent of the hierarchy is to provide management flexibility and production change opportunity at the activity/task level while keeping stability at the mission/function/process level.

d. The single manager within NAVSUP for each process is indicated in the next to last column of figure 2. For some processes, managers outside of NAVSUP have Navy-wide responsibilities; those managers are indicated in the last column of figure 2.

e. NAVSUP headquarters will be the arbitrator in any functional ownership contentions.

2. TECHNOLOGY PROJECTIONS

a. The following are attributed to Information Week, January 19, 1987. In general, they apply to the NAVSUP environment as well.

(1) Strategic Networking. Reliance on and investment in the strategic potential of electronically transmitted data, voice, and image both inside and outside the enterprise will increase steadily as reliance on sheer volume of stored numerical data declines reflecting its value primarily as a support resource.

(2) Corporate Consolidation. Current "Mergermania" will further intensify before it wanes, thus fueling the emergence of a two-tiered vendor environment where a comparatively small number of large corporations do most volume business and a flourishing legion of entrepreneurial firms account for the majority of product innovations.

(3) Bureaucratic Barriers. Traditional bureaucratic barriers separating large-organization departments and personnel will weaken as firms move to establish organically functioning, continuously interactive, electronically linked operations, with a workforce seamlessly united in pursuit of overall corporate goals.

(4) Management Realignment. The distortion of traditional pyramid management structures will accelerate as automation reduces entry level jobs, broadens the decision making capability and power of middle management specialists and by eliminating the ensuing redundancy, simplifies management at the top echelon.

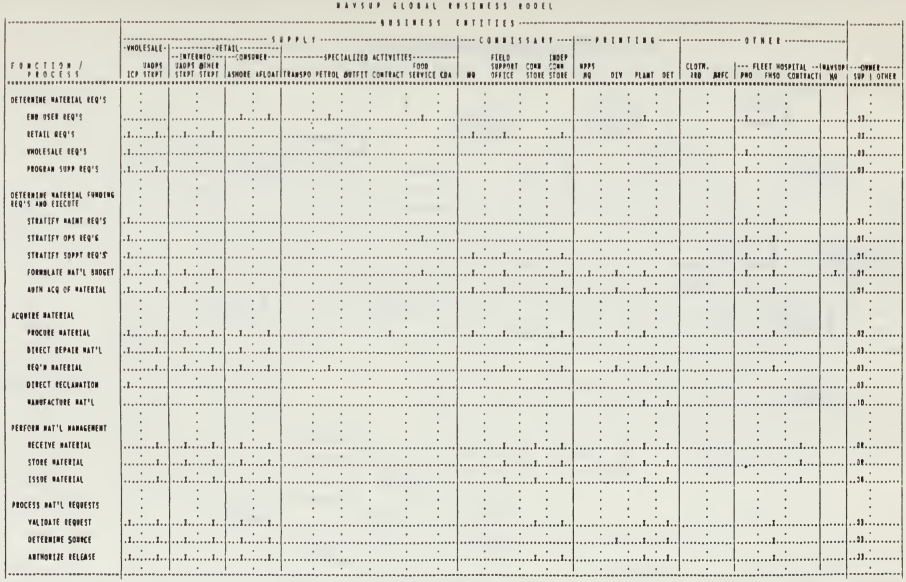


Figure 2

Figure B-1. NAVSUP Global Business Model

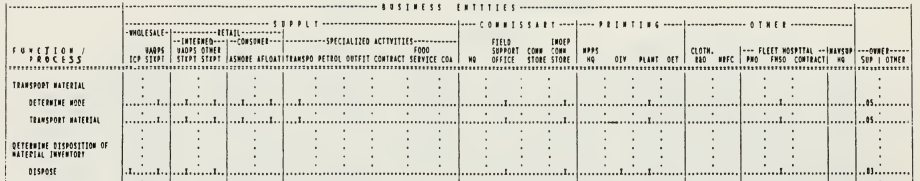


Figure 2

Figure B-1. NAVSUP Global Business Model (Cont.)

NAVSUP INFORMATION FLOW

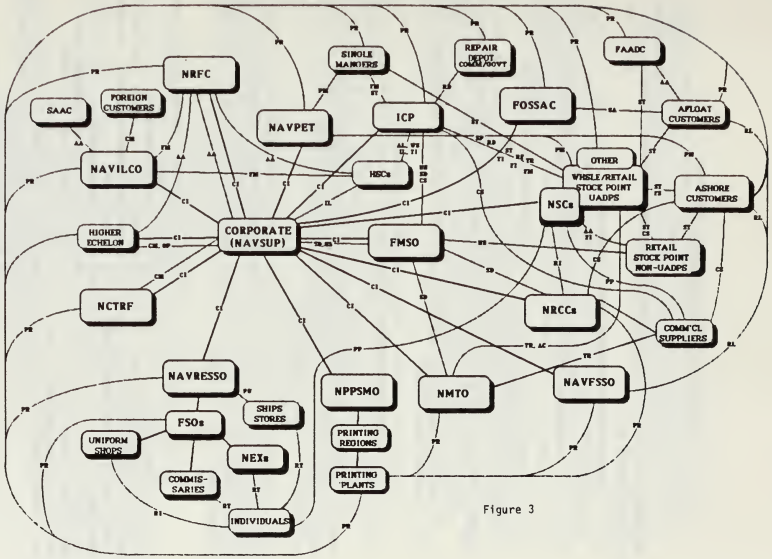


Figure 3

NAVSUP INFORMATION FLOW

A. ORGANIZATIONS SHOWN IN THE ATTACHED FIGURE ARE IDENTIFIED IN ONE OF THREE WAYS:

1. ORGANIZATIONS WITHIN NAVSUP'S CLAIMANCY
2. OTHER ORGANIZATIONS WITH WHICH NAVSUP ORGANIZATIONS INTERACT
3. HYBRID ORGANIZATIONS, SOME OF WHICH ARE IN NAVSUP'S CLAIMANCY, i.e., NAVAL SUPPLY CENTERS

B. CONNECTING DATA FLOW LINES ARE SHOWN IN ONE OF TWO WAYS:

1. INDICATES INFORMATION FLOW ASSOCIATED WITH A SUPERIOR/SUBORDINATE COMMAND RELATIONSHIP
2. INDICATES FUNCTIONAL SUPPORT RELATIONSHIP

C. ANNOTATED ON EACH INFORMATION FLOW LINE IS AT LEAST ONE ALPHA-ALPHA NOTATION OF BROAD GROUPS OF FUNCTIONAL INFORMATION. THESE GROUPS ARE:

AA APPN ACCTG/BILLING
AC AIR CLEARANCE
AI AD HOC INQUIRIES
AL ALLOWANCE INFO
CI CORPORATE MANAGEMENT, INCLUDING
- AI OB
- IG OP
- IS OR
- MR PO

CM CASE MANAGEMENT (FMS)
CR CONTRACT MANAGEMENT REVIEW
FI FINANCIAL INVENTORY ACCTG
FM FOREIGN MILITARY SALES TRANSACTIONS
IG INSPECTION
IL ILS, INCLUDING PPRs
IS INFOR SYSTEM APPROVALS
MC MILITARY CLOTHING MATTERS
MR MANAGEMENT OVERSIGHT
NS NAVY STOCK FUND BUDGETING
OB OPERATING BUDGET FORMULATION, POM, EXECUTION
OP SUPPLY CORPS MANAGEMENT
PM PETROLEUM MGMT, INCLUDING FACILITIES, RQMTS, QC
PO POLICY
PP PERSONAL PROPERTY, INCLUDING QC
PR PRINTING REQUEST
RD REDISTRIBUTION ORDERS
RF REFERRALS
RL RATION LAW ADMINISTRATION
RO REPAIR ORDERS
RT RESALE TRANSACTIONS
SA OUTFITTING / SUPPLY ASSISTANCE
ST SUPPLY TRANSACTIONS, INCL REQNS, STATUS, BILLING
SD SYSTEM DEVELOPMENT
SP STANDARD PRICES
TI TECHNICAL INFORMATION
TR TRANSACTION REPORTING
WS WEAPONS SYSTEM CONFIGURATION

Figure 3

6-7

(5) Automated Expertise. Artificial-intelligence-oriented software technology will cease to be esoteric, with the strategic potential ... as well as the limitations... of expert systems becoming clear to the non-scientific world and implementation becoming commonplace among non-technical corporate personnel.

(6) User Sophistication. The isolation of the computer neophyte, both within the corporation and among the consuming public, will end, as technical proficiency is either dispersed through education and experience or rendered unnecessary by the availability of increasingly "friendly" product offerings.

(7) Reoriented Distribution. The demand for prompt, if not instantaneous, service and product delivery will heat up within the consuming public, thus placing distribution on a par with product development as a primary strategic consideration. This will spur growth in vendor-owned, electronically supported distribution systems and erosion of reliance on third-party distributors.

(8) Technology Redirection. With the maturing of currently nascent hardware, software, and communications technologies, the conceptual parameters of information technology will finally have been established. This will require users to direct their energies toward creative optimization of existing equipment and concepts rather than delay action in anticipation of additional revolutionary breakthroughs.

(9) Consumer Expectations. The steady demystification of high technology will decrease consumer intimidation, a significant consequence of which will be a correspondingly steady escalation in the buying public's expectations and demands for excellence in both products and services.

b. IS technology will continue to evolve at an accelerating rate of change through the foreseeable future.

c. The rate of technology change is too rapid for effective implementation or utilization of each technological advance in large, complex information systems.

d. Relational data base technology will further develop so that current cost disadvantages will diminish.

e. IBM's long range direction toward its Strategic Application Architecture will accelerate information system integration and interoperability opportunities.

Trusted computer certification will continue to lag well behind demands for increased ADP security.

6-8

3. INFORMATION SYSTEMS TECHNICAL STRATEGIES

a. NAVSUP's capstone Information System strategy is to make data and information available to those with authorization and need to support effective and efficient accomplishment of NAVSUP's mission and business strategies.

b. A corollary to paragraph 3.a, preceding, is that the information required to support NAVSUP's business and functional strategies is the rational basis for NAVSUP's information systems strategy.

c. Implicit in the foregoing strategies is the need to expand the historical focus of information support from a supply-transaction, record-keeping orientation to a managerial and executive support orientation at all levels to facilitate better and more timely decision making.

d. NAVSUP will confirm or modify the business model and information categories of figures 2 and 3 through modern Computer Aided Software Engineering (CASE) tools.

e. A highly disciplined methodology will be employed to ensure that data and business models are transportable and efficient.

f. Data and business models will be independent of information system execution technology.

g. NAVSUP will utilize an information system technical plan, available to all information system planners and developers, that fosters convergence of individual information systems into a virtual, single system.

h. NAVSUP must remain in a position to take advantage of modern information technology such as:

- Data and processing distribution

- The growing power and efficiency of relational data base technology.

- Intelligent work stations (IWS) in the hands of end users throughout the supply system including managers and executives.

- Intelligent network capabilities.

- Artificial intelligence.

i. Based on the preceding paragraph h, NAVSUP will operate a logical three-tier information processing architecture. These tiers are: Production, Departmental, and End

User. Figure 4 provides examples of data and applications resident in the three tiers.

j. NAVSUP will pursue a policy of technology refreshment to maintain installed information systems at or near the state-of-the-art for the applicable technologies.

k. New technologies will be acquired as required to exploit business process opportunities and/or reduce information systems life cycle costs.

l. New/enhanced technologies will be selected/applied based upon a decision matrix which considers cost amortization period, improved business process, impact of implementation, technology life, compliance with architectures, and compatibility with co-resident technclogies.

m. Based on information engineering principles, there may be rational segmentation of data among production values (latest values), archive, and management information.

n. Expert systems will be used to document decision rules and facilitate further automation.

o. Functional requirements will drive technical solutions within the constraints of the systems architecture.

p. In recognition of the trauma associated with change, the introduction of change in technology and information systems should be planned to minimize negative impact on the efficiency and effectiveness of the business process.

q. Production applications and their supporting data will be centrally managed and developed. Management and information product applications may be developed locally but catalogued centrally.

r. NAVSUP will look first to functional owners for data processing functionality. Unique systems will be developed only where significant data incompatibility or negative impact on business exists.

s. There will be independent processes to support applications, data base access, and data base management to maximize portability and minimize costs of development and maintenance.

t. Data systems use and development will take place at the appropriate level of management hierarchy commensurate with function responsibility.

u. Annually, NAVSUP will review and assess information processing technology enhancements and opportunities to ascertain their efficacy for improving the cost effectiveness of NAVSUP information processing and business functions.

EXAMPLES OF DATA AND APPLICATIONS
RESIDENT IN THREE-TIER ARCHITECTURE

TIER	TYPE OF DATA	TYPE OF APPLICATIONS	AUTHORITY RESPONSIBILITY
1.	CORPORATE WIDELY SHARED RAW DATA DATA DERIVED FOR PRODUCTION HISTORICAL DATA	DATA ESTBLSH DATA CHANGE CENTRALLY MGD CENTRALLY MNTD PROCESS CARRIED TO LOGICAL CONCLUSION	SUP FUNCTIONAL OWNER
2.	CORPORATE DOWNLOAD AUGMENTED WITH ADDITIONAL/DERIVED DATA.	DATA USE/ MANIPULATION TRANSACTION PREPARATION AD HOC QUERY REPRESENTS PROCESS CTRLS DOCUMENT STORAGE DISTRIBUTION	MANAGEMENT AT THIS LEVEL
3.	SPECIALIZED DWNLD DERIVED DATA PERSONAL DATA	DECISION SUPPORT SYSTEMS TRANS PREP DOCUMENTATION PREP	INDIVIDUAL

Figure 4

v. Technology assessment will be synchronized with the POM process such that the funding for selected technology opportunities will be put in place in a timely fashion.

w. NAVSUP information systems will exploit automation for managing systems and business processes.

x. Communications network capacity should be sufficient to support the full range of required transmission capabilities, including multi-station Video Teleconferencing; real-time, 3D, technical documents; batch file transfers; and interactive processing among supply support nodes. Additionally, sufficient incremental capacity should be available to support the latter two functions for the entire logistics community and for internal NAVSUP 3D technical document transmissions.

y. Strategic architectures and guidelines for data, applications, networks, and support systems will provide the framework for all information system acquisition and development to promote convergence of individual systems into a virtual, single system.

B. INFORMATION PROCESSING ARCHITECTURE

This paragraph fleshes-out the four architectures of the third level in figure 1. Implementation guidelines accompany each architecture.

1. DATA ARCHITECTURE

a. Figure 5 models NAVSUP's Data Architecture for managing data as a corporate resource. The following paragraphs amplify the figure and describe the concepts of data management within NAVSUP Information Systems:

b. Beginning at the lower left of figure 5, the first step in data management is to model the data and their inter-relationships. This model is independent of organizations and business processes that use the data; focusing solely on the data. The model encompasses all NAVSUP so that data for all business entities are subsets of the logical corporate data model.

(1) The logical data model is the primary basis of the data dictionary located in the lower center of figure 5. The data dictionary contains, or points to, data describing each business data entity.

(2) Behind the data dictionary lies the business model. The data dictionary contains additional data relating DENs to specific business model functions and processes.

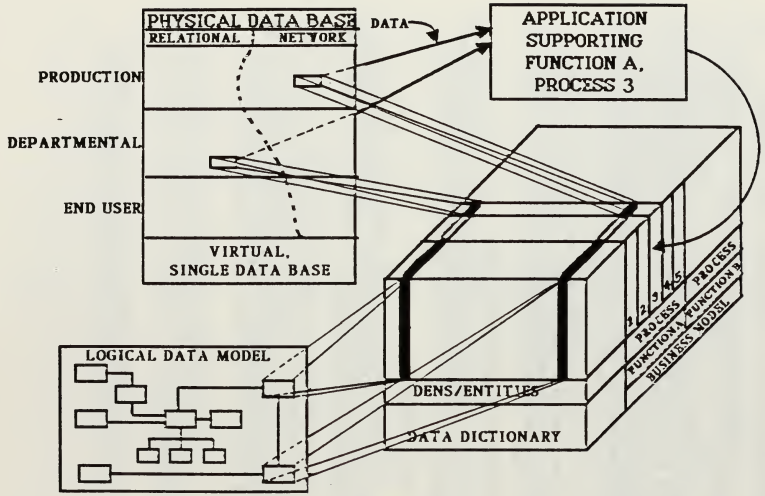


Figure 5

Figure B-2. Data Architecture

(3) The data dictionary also forms the basis for controlling which processes (or individuals), and applications have access to and management responsibilities for data in the physical data base located in the upper left portion of figure 5.

(4) The physical data base is a three-tier arrangement corresponding to the logical three-tier architecture: production, departmental, and end user. Data dictionary discipline applies to all tiers. Network data bases should only be employed in currently operating information systems. All new development will employ relational technology as first choice. Exceptions to this policy must be approved by the System Architect. Over time, relational data base technology will replace network data base technology. Individual elements of the data base may be geographically dispersed.

(5) An application supporting a specific business process appears in the upper right portion of the model. Data is extracted from the virtual, single data base based on the control parameters of the dictionary and then used in the business application directly supporting the business process.

c. With the three-tier strategy, data transmissions between tier data bases and deriving data from higher level tiers must be carefully managed. Figure 6 provides the Data Transmission Architecture.

(1) Central to this architecture is a Data Distribution Manager that physically directs data updates from one tier to another.

(2) Production, Departmental and End User Data Dictionaries are subsets of the Corporate Data Dictionary. Corporate Data Dictionary discipline applies to all tiers and facilitates access control to data by the Data Distribution Manager.

(3) Data transmission applications enhance data from one tier to another; for example, when data from the production tier may be combined into summary data for use at the Departmental or End User tier.

2. DATA MANAGEMENT GUIDELINES

a. The principles of Information Engineering will be used to model data for corporate data bases. The principles require that data must be analyzed in sufficient detail to eliminate ambiguous data associations and redundant data entities. This normalized data may then be used in conjunction with similarly detailed analyses of the business processes to organize the business in the most effective manner.

b. A single, corporate, logical, data model will be developed. Figure 7 summarizes the results of using CASE technology at the strategic data modeling level which may cause

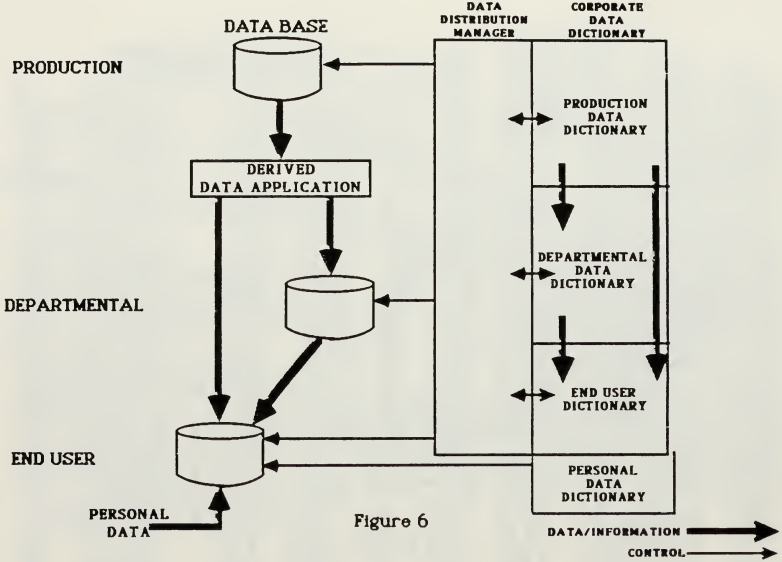
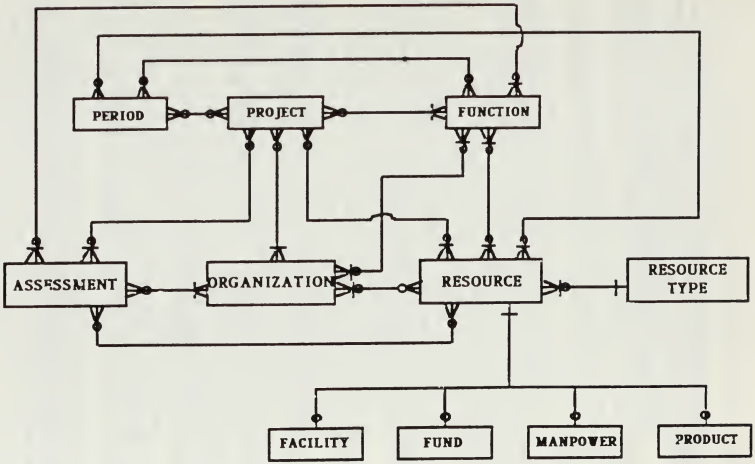


Figure B-3. Data Transmission Architecture

CORPORATE DATA MODEL (STRATEGIC LEVEL)



NOTE: MANY TO MANY ASSOCIATIONS ARE UNRESOLVED IN THIS DATA MODEL

Figure 7

figures 2 and 3 to be modified in ensuing CIMPs.

c. Corporate data administration will be supported by an encompassing metadata base which supports development access, redundancy management, data ownership and value validation.

d. Logical data modeling is independent of physical implementation and will not be compromised to facilitate use of a specific software product.

e. Data redundancy across the tiers may be necessary. The production data base will be the source of authoritative data values.

f. Multiple data base technologies are desirable both across the processing tiers in order to support performance and within tiers to support functionality. The System Architect will designate and license specific DBMS's to provide this flexibility. The technical review process will maintain the DBMS opportunities current.

g. Production data segmentation strategy will be based on information engineering principles to decide issues such as the separation of current values from past values to support transaction performance and audit/analysis.

h. Departmental and end user data bases will be supported by periodic snapshots of higher-tier data bases augmented by tier unique data.

i. Data Access control will be supported by establishing and maintaining specific sub-sets of the corporate Metadata base as access controllers on top of the data repositories.

j. Tiers 2 and 3 and external sources will create transactions which update the authoritative, corporate data in tier 1. Updates will occur at the tier that owns the data, but tier hierarchy relationships will be maintained.

k. Data interchange between and among nodes will use electronic data interchange (EDI) constructs.

l. Data are defined as facts or propositions used to draw a conclusion or make a decision. They are the inputs of an information system and may take a number of different forms such as image, various values, text, graphics or voice.

m. Data group archiving strategy will be effected in the metadata base. The strategy will consider both accessible storage options/economics and possibilities of use/need. For example, platform depot overhaul intervals approaching 15 years suggest demand cycles 15 years long for appropriate records.

3. APPLICATION ARCHITECTURE

a. Figure 8 portrays NAVSUP's Application Architecture.

(1) The principal control agents in this architecture are tier-specific data dictionaries and user profiles which control access to data by applications and designate data management responsibilities.

(2) Tier-specific data dictionaries are subsets of the Corporate Data Dictionary.

(3) Derived data applications are part of the data distribution management function discussed in the Data Architecture, figure 6.

4. APPLICATION GUIDELINES

a. Functional support ADP system development will recognize the distinction/segmentation between process,data entry/exit and data management. All should be developed as independent but related processes.

b. Designated Computer Assisted Software Engineering (CASE) technology will be used for system design, development and maintenance for centrally managed applications.

c. User involvement will be maintained through active prototype methodologies inherent in CASE and through total system life cycle. Prototype acceptance will constitute test/evaluation/op-review. The user for any process under development is the worker, the user of the process product, and management. The functional manager will adjudicate if contentions arise. Part of the prototype process will be to determine and assess risk to supply and Navy resources that may result from the process.

d. Unit of program will be the lowest level within CASE development technology which has an input and an output. Input can be from a data base or from another program within the same application or from an external source. Output can be to a data base or another program within the application or a view.

e. Programs which establish or change data in the corporate data base will always be centrally managed and maintained.

f. The System Architect will define the universe of tools, either centrally developed or off-the-shelf, to be supported (word processors, spread sheets, expert system shells, etc.).

g. Programs which execute designated policy will be centrally developed, managed and maintained.

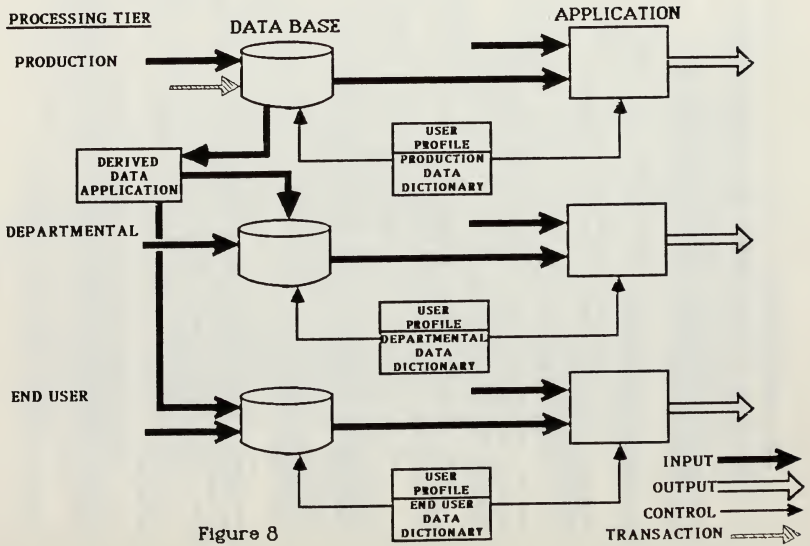

APPLICATION ARCHITECTURE
PROCESSING TIER
DATA BASE
APPLICATION
PRODUCTION
USER PROFILE
PRODUCTION DATA DICTIONARY
DERIVED DATA APPLICATION
DEPARTMENTAL
USER PROFILE
DEPARTMENTAL DATA DICTIONARY
END USER
USER PROFILE
END USER DATA DICTIONARY
INPUT
OUTPUT
CONTROL
TRANSACTION

Figure 8

h. Programs which generate management information/marginal analysis/"what if" analysis can be developed locally.

i. Programs which generate information products (procurement instruments, technical packages, etc.) may be developed locally. It is understood that the product content will remain constant; format and media may vary.

j. With the CASE development process, logic and action diagrams will be developed independently of a target language or processing environment.

k. A repetitive-use central software configuration catalog containing both centrally managed and locally developed programs will be maintained by the Central Design Activity (FMSO).

l. All updates and changes to corporate data will be ledgered. (Note: This is to be a data service....not an application function.)

m. As stated in paragraph A.3.s, above, there will be independent processes to support applications, data base access, and data base management to maximize portability and minimize cost of development and maintenance.

n. Applications will be developed using languages that provide the least total life cycle cost of the system and the supported business processes.

5. NETWORK ARCHITECTURE

a. NAVSUP telecommunications facilities will be integrated into a single logical network as indicated in figure 9. This network is called the NAVSUP Logistic Network (NLN).

b. Physically distinct subnets, based on security classification, community of interest, regional or campus orientation, or host processing suite will co-exist with and complement the NLN, unless specifically exempted.

c. In general, the standard NAVSUP internal architecture is a Systems Network Architecture (SNA) implementation, focusing inward to the ICP or SPAR central processing hosts. Non-IBM compatible processing devices wishing access to the internal network must support SNA compatibility in communications hardware and software, in addition to any native mode telecommunications capabilities provided within a regional area.

NAVSUP LOGISTIC NETWORK (NLN) ARCHITECTURE

Figure 9

6. NETWORK GUIDELINES

a. SPLICE will provide most of the long-haul communications capabilities of the NLN nodes during its economic life. Its replacement will be hardware and software acquired via technological refreshments from the ICP and SPAR contracts.

b. Telecommunications capacity will be provided in two operational areas:

(1) Interoperable Communications -

(a) Government Open Systems Interconnection Profile (GOSIP) will be the standard method for interoperable long haul data communications. Until the implementation of GOSIP, the Defense Data Network (DDN) with the DOD mandated lower level protocols will be used. Gateways will be provided which utilize the upper level DOD protocols. Nodes will have at least two DDN host connections terminating at different Packet Switching Nodes (PSNs).

(b) All NAVSUP activities will install a backbone IEEE 802.5 compatible Local Area Network (LAN) in the near future. These installations will be done with the approval of the local coordinator of the Base Information Transfer System (BITS) project. Other sites using NAVSUP Automated Information Systems (AISs) will implement a LAN in accordance with the BITS project. In either case, most workstations/terminals will be attached to this LAN. At NAVSUP activities, bridges to other IEEE 802 series standard LANs will be used, if required for projects such as EDMICS.

(c) Voice communications will be used as provided via the BITS or Bases and Stations Information System (BASIS) projects.

(2) Closed community -

(a) Selected DDN connection will be used for closed community operations (i.e., NLN host-to-NLN host only). Optimized vendor unique X.25 and upper level protocols will be used.

(b) Government provided and contractor provided leased lines will be used to supplement DDN, where required.

(c) The NAVSUP Video Teleconferencing project will be implemented at all NAVSUP Stock Points, as well as HQ and the ICPs. This project will allow shared use of their large communications "pipes" for data traffic, as well as video.

c. The NLN community will standardize on Personal Computers (PCs) as intelligent workstations. These devices will

be capable of supporting several vendor unique protocols through the use of hardware boards and software communications packages. "Dumb" terminal devices will be phased-out on a priority basis.

d. The NLN community will standardize on PC attached, slow speed printers and front-end processor (FEP) attached high/medium speed and laser printers for non-computer room print requirements.

e. Card reader/punch equipment will not be supported anywhere on the network nor in any FMSO designed modernization applications. Card reader/punch equipment used in support of external customers will be phased out at the earliest possible date.

f. "Lights out" data center operations and personnel reductions will force remote data communications management and problem diagnosis to be centralized at the NAVSUP Network Control Center. Local sites will use any remaining telecommunications resources as LAN support personnel.

g. Host channel connections vice LAN gateways will interconnect the heterogeneous host equipment at a node, if interconnection is required.

h. On-line file transfers will be accomplished among regionally co-located heterogeneous hosts via IBM protocols. Homogeneous hosts may use more optimized off-the-shelf host transfer methods. PC-to-host file transfers will be supported via native mode host/PC off-the-shelf software packages.

i. The IBM NETVIEW product will be the strategic network management and control product implemented at all levels of the network, including the TANDEM nodes.

j. Network control equipment, modems, and LAN equipment will be purchased from the SPAR and ICP Resolicitation contracts containing those required equipment items.

k. Only full screen, block mode applications written in accordance with the above will be used on the network.

7. SUPPORT SYSTEM ARCHITECTURE

a. The Support System Architecture shown in figure 10 is intended to assure interoperability across all tiers and to promote re-use of application software throughout the supply system.

b. The Corporate Data Dictionary in conjunction with the Business Model will control applications as they relate to business processes.

SUPPORT SYSTEM ARCHITECTURE

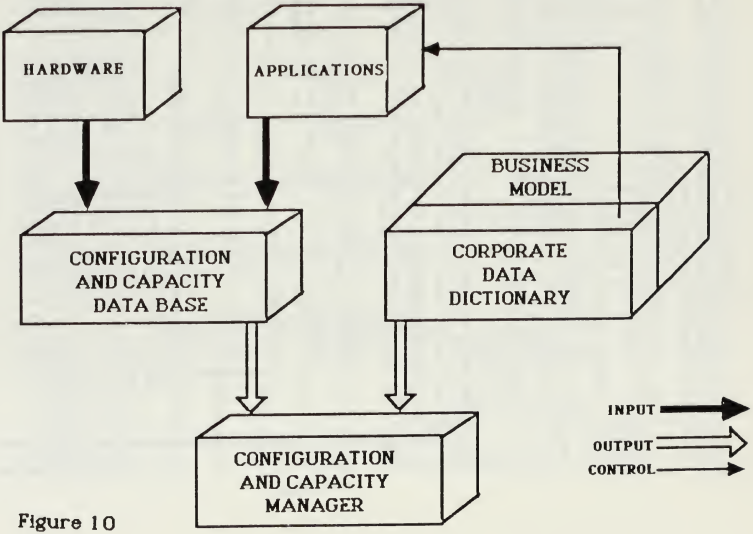


Figure 10

c. The Configuration and Capacity Data Base will contain hardware inventory information and capacity metrics as well as operating system software and business application software inventory information and metrics.

d. The Configuration and Capacity Manager is a decision support system providing standard reports as well as ad hoc analytical capabilities.

8. SUPPORT SYSTEM GUIDELINES

a. The Support System Configuration Accounting and Management System will be the same methodology as that used by Navy for Weapon System configuration management (SCLSIS).

b. System hardware and software will support the multi-tiered data architecture.

c. NAVSUP activity system configuration will be compatible to allow mutual processing/support between sites. The System Architect will develop and maintain a menu of system support software to facilitate this compatibility.

d. Each NAVSUP business function will be supported by a consistent set of hardware and system software in order to assure commonality of processing across sites.

e. System will support Electronic Data Interchange protocol interaction between sites and customer/user systems.

f. Commercially developed and maintained hardware and software will be utilized by all NAVSUP sites and systems.

g. System hardware and software will support automated operations.

h. Capacity planning and management will take place centrally.

i. System performance and capacity standards will be developed and maintained by the System Architect.

9. Summary: The overall technical view embodied in this plan is pictured in figure 11. Implementing the concepts behind the strategies and guidelines discussed in this section of the plan will require support of end users, data processing and telecommunications professionals throughout NAVSUP and other Navy supply activities. Realistically, full implementation of these architectures will not be achieved before the mid-1990's. In the short term, NAVSUP will review its information system development policies and revise or issue policies to enable achieving figure 11.

NAVSUP TARGET TECHNICAL ARCHITECTURE

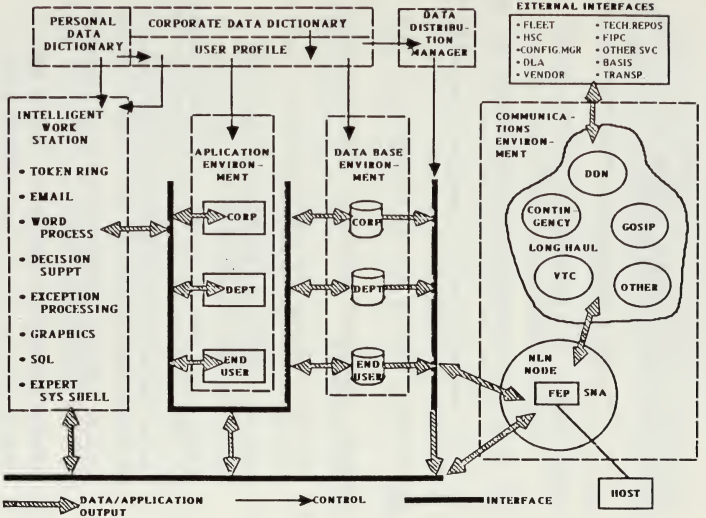


Figure 11

APPENDIX C

NAVSUP DATA ADMINISTRATOR SURVEY

1. Does the Data Administrator perform data administration functions full-time or part-time?

2. If part-time, approximately what percentage of time is spent on data administration?

3. How many people that perform data administration functions work directly for the DA?

4. What is the title and code of the person the DA reports to?

5. Is a Data Base Administrator assigned (yes/no)? If yes, full-time or part-time?

6. What is the title and code of the person the DBA reports to?

7. Check the following functions and responsibilities the DA has performed:

   a. Implement policies and standards on activity/corporate databases.

   b. Maintain logical and physical integrity of activity/corporate databases.

   c. Evaluate and approve proposals for local unique databases and use of activity/corporate databases.

   d. Ensure logical and physical database design of activity databases comply with NAVSUP policies.

   e. Monitor activity databases to ensure adherence to approved standards.

   f. Prepare and maintain database resource plan.

   g. Identify and resolve inconsistencies within corporate data structure.

   h. Draft, for Headquarters DA establishment, MOA/SLAs with appropriate CDAs as required.

i. Develop and execute operational and management training on data management.

j. Provide recommendations to the NAVSUP DA on changes in database management policy and procedures.

k. evaluate proposals from field activities and external CDAs relating to changes in policy and structure associated with data management, and made appropriate recommendations.

l. Identify data sharing opportunities.

m. Develop tactical/strategic plans for data use.

n. Identify potential database applications.

8. Does the DA use a Data Dictionary or Dictionaries in carrying out assigned functions and responsibilities? (yes/no)

   a. If yes, is the primary DD active or passive?

   b. Approximately how many entries are in the primary DD?

   c. Who makes inputs to the DD? (DA, DBA, Systems, Applications, or other)

   d. Check the primary uses of the DD:

      1. As a tool for Systems Planning.

      2. As a tool for Requirements Definition and Analysis.

      3. As a tool for Design, Implementation, Testing, Operation and Maintenance.

      4. As a tool for Documentation and Standards.

      5. As a tool for Operational Control Through Metadata Generation and Metadata Audit Trail.

      6. As a tool to Support the Distributed Database Environment.

      7. List other uses:

9. Does the DA feel that the data administration concept, as it is organized at her/his activity, has been successful?

   yes no

   partially don't know or too early to tell

10. Check the Data Administration and Management problems that exist within your activity:

    a. Lack of qualified DA staff.

    b. Inadequate grade levels (salaries).

    c. Not enough responsibility.

    d. Too heavy a workload.

    e. Responsibility without corresponding authority.

    f. Resistance by others to changing job responsibilities.

    g. lack of enough management support.

    h. DA group not placed high enough in the organization.

    i. Resistance to data sharing by users.

    j. Resistance to data sharing by systems people.

    k. Management lack of understanding of the Data Administration concept.

    l. List other problems:

11. Check any benefits, perceived or real, that your activity has realized from the use of a data dictionary:

    a. Elimination of redundant metadata definition.

    b. Insured consistency in the metadata.

    c. Establishment of control over metadata usage.

    d. Establishment of control of metadata changes.

    e. Implementation of data independence.

    f. Reduced coding (active DD).

    g. Consistency of documentation.

    h. List other benefits realized:

12. If you have time, please comment on major data administration and management directions you plan to take in the future.

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